United States
Environmental
Protection Agency

Office of Water
(4601)

EPA [No. TBD]
July 2003
Draft

STAGE 2 DISINFECTANTS AND DISINFECTION BYPRODUCTS RULE

INITIAL DISTRIBUTION SYSTEM EVALUATION

Note on the Stage 2 Disinfectants and Disinfection Byproducts Initial Distribution System Evaluation Guidance Manual, July 2003 Draft

Purpose:

The purpose of this guidance manual, when finalized, is solely to provide technical information for water systems and States to use for compliance with the Initial Distribution System Evaluation (IDSE), a component of the Stage 2 Disinfectants and Disinfection Byproducts Rule (Stage 2 DBPR). EPA is developing the Stage 2 DBPR to reduce DBP occurrence peaks in the distribution system based on changes to compliance monitoring provisions. Chapter 1 of this manual contains additional information about this regulation.

This guidance is not a substitute for applicable legal requirements, nor is it a regulation itself. Thus, it does not impose legally-binding requirements on any party, including EPA, states, or the regulated community. Interested parties are free to raise questions and objections to the guidance and the appropriateness of using it in a particular situation. Although this manual describes many methods for complying with IDSE requirements, the guidance presented here may not be appropriate for all situations, and alternative approaches may provide satisfactory performance. The mention of trade names or commercial products does not constitute endorsement or recommendation for use.

Authorship:

This manual was developed under the direction of EPA's Office of Water, and was prepared by The Cadmus Group, Inc. and Malcolm Pirnie, Inc. Questions concerning this document should be addressed to:

Thomas Grubbs and Elin Warn
U.S. Environmental Protection Agency
Mail Code 4607M
1200 Pennsylvania Avenue NW
Washington, DC 20460-0001
Tel: (202) 564-5262 (Thomas Grubbs)
(202) 564-1807 (Elin Warn)
Fax: (202) 564-3767
Email: Grubbs.Thomas@epamail.epa.gov and Warn.Elin@epamail.epa.gov

Request for comments:

EPA is releasing this manual in draft form in order to solicit public review and comment. The Agency would appreciate comments on the content and organization of technical information presented in this manual. Please submit any comments no later than 90 days after publication of the Stage 2 Disinfectants and Disinfection Byproducts Rule proposal in the *Federal Register*. Detailed procedures for submitting comments are stated below.

Acknowledgements:

American Water Works Association
Association of Metropolitan Water Agencies
Andrew DeGraca—San Francisco Water
Walter Grayman—W.M. Grayman Consulting
Mike Grimm—Oregon Health Department
Rich Haberman—California Department of Health Services
Mike Hotaling—City of Newport News
Alexa Obolensky—Philadelphia Water Department
David Reckhow—University of Massachusetts Amherst
Tom Schaeffer—Association of Metropolitan Water Agencies
Charlotte Smith—Charlotte Smith & Associates
Vanessa Speight—University of North Carolina
Scott Summers—Colorado University
Jim Uber—University of Cincinnati
Marguerite Young—Clean Water Action

Procedures for submitting comments:

Comments on this draft guidance manual should be submitted to EPA's Water Docket. You may submit comments electronically, by mail, or through hand delivery/courier.

- To submit comments using EPA's electronic public docket, go directly to EPA Dockets at http://www.epa.gov/edocket, and follow the online instructions for submitting comments. Once in the system, select "search," and then key in Docket ID No. OW-2002-0039.

- To submit comments by e-mail, send comments to OW_Docket@epa.gov, Attention Docket ID No. OW-2002-0043. If you send an e-mail comment directly to the Docket without going through EPA's electronic public docket, EPA's e-mail system automatically captures your e-mail address, which is included as part of the comment that is placed in the official public docket.

- To submit comments on a disk or CD ROM, mail it to the address identified below. These electronic submissions will be accepted in WordPerfect or ASCII file format. Avoid the use of special characters and any form of encryption.

- To submit comments by mail, send three copies of your comments and any enclosures to: Water Docket, Environmental Protection Agency, Mail Code 4101T, 1200 Pennsylvania Ave., NW, Washington, DC, 20460, Attention Docket ID No. OW-2002-0043.

- To submit comments by hand delivery or courier, deliver your comments to: Water Docket, EPA Docket Center, Environmental Protection Agency, Room B102, 1301 Constitution Ave., NW, Washington, DC, Attention Docket ID No. OW-2002-0043.

Please identify the appropriate docket identification number in the subject line on the first page of your comment. If you submit an electronic comment, please include your name, mailing address, and an e-mail address or other contact information in the body of your comment. Also include this contact information on the outside of any disk or CD ROM you submit, and in any cover letter accompanying the disk or CD ROM.

For public commenting, please note that EPA's policy is that public comments, whether submitted electronically or in paper, will be made available for public viewing in EPA's electronic public docket as EPA receives them and without change, unless the comment contains copyrighted material, confidential business information, or other information whose disclosure is restricted by statute.

Contents

Appendices

Tables and Figures

Tables

Figures

Acronyms

CWS	Community water system
CT	Residual disinfectant concentration (in mg/L) multiplied by the contact time (in min)—a measure of inactivation
DBP	Disinfection byproduct
DBPR	Disinfectants and Disinfection Byproducts Rule
EPS	Extended period simulation
HAA	Haloacetic acid
HAA5	The sum of five HAA species
HPC	Heterotrophic plate count
ICR	Information Collection Rule
IDSE	Initial distribution system evaluation
LRAA	Locational running annual average
LT2ESWTR	Long Term 2 Enhanced Surface Water Treatment Rule
MCAA	Monochloroacetic acid
MCL	Maximum contaminant level
M-DBP	Microbial and disinfection byproduct
NPDWR	National Primary Drinking Water Regulation
NTNCWS	Nontransient noncommunity water system
PWS	Public water system
RAA	Running annual average
SDS	Simulated distribution system
SDWA	Safe Drinking Water Act
SMP	Standard monitoring program
SSS	System-specific study
SWTR	Surface Water Treatment Rule
TCAA	Trichloroacetic acid
TCR	Total Coliform Rule
THM	Trihalomethane
TOC	Total organic carbon
TNCWS	Transient noncommunity water system
TTHM	Total trihalomethanes
UV	Ultraviolet light

Definitions

Aquifer: a geological formation composed of rock, gravel, sand, or other porous material that yields water to wells or springs.

Best professional judgement: using knowledge and experience to make a decision on an issue that does not have a clear direction or answer, or deciding to take an alternative path to the one recommended based on knowledge and experience.

Booster disinfection: the practice of adding disinfectant in the distribution system to increase disinfectant residual concentration.

Combined distribution system: the interconnected distribution system consisting of the distribution systems of wholesale systems and of the consecutive systems that receive finished water from those wholesale system(s). 40 CFR 141.2

Community water system: a public water system which serves at least 15 service connections used by year-round residents or regularly serves at least 25 year-round residents. 40 CFR 141.2

Conductivity: a measurement of the ability of a solution to carry an electrical current.

Consecutive system: a public water system that buys or otherwise receives some or all of its finished water from one or more wholesale systems for at least 60 days per year. 40 CFR 141.2

Consecutive system entry point: a location at which finished water is delivered at least 60 days per year from a wholesale system to a consecutive system. 40 CFR 141.2

Controlling month: the month of historical peak DBP levels, or, in the absence of DBP data, the month of highest water temperature by which the IDSE sampling schedule is set.

Disinfectant: any oxidant, including but not limited to chlorine, chlorine dioxide, chloramines, and ozone added to water in any part of the treatment or distribution process, that is intended to kill or inactivate pathogenic microorganisms. 40 CFR 141.2

Disinfectant residual concentration: the concentration of disinfectant that is maintained in a distribution system. Disinfectant could be free chlorine (the sum of the concentrations of hypochlorous acid (HOCl) and hypochlorite acid (OCl^-)) or combined chlorine (chloramines). It is used in Surface Water Treatment Rule as a measure for determining CT.

Disinfection: a process which inactivates pathogenic organisms in water by chemical oxidants or equivalent agents. 40 CFR 141.2

Disinfection byproduct (DBP): compound formed from the reaction of a disinfectant with organic and inorganic compounds in the source or treated water during the disinfection process.

Dual Sample set: TTHM and HAA5 samples that are taken at the same time and location for the purpose of conducting an IDSE evaluation and determining compliance with the TTHM and HAA5 MCLs.

Finished Water: water that has been introduced into the distribution system of a public water system and is intended for distribution without further treatment, except that necessary to maintain water quality (such as booster disinfection). 40 CFR 141.2

Ground water under the direct influence of surface water (GWUDI): any water beneath the surface of the ground with (1) significant occurrence of insects or other macroorganisms, algae, or large-diameter pathogens such as *Giardia lamblia*, or (2) significant and relatively rapid shifts in water characteristics such as turbidity, temperature, conductivity, or pH which closely correlate to climatological or surface water conditions. Direct influence must be determined for individual sources in accordance with criteria established by the State. The State determination of direct influence may be based on site-specific measurements of water quality and/or documentation of well construction characteristics and geology with field evaluation. 40 CFR 141.2

Haloacetic acid (HAA): one of the family of organic compounds named as a derivative of acetic acid, wherein one to three hydrogen atoms in the methyl group in acetic acid are each substituted by a halogen atom (namely, chlorine and bromine) in the molecular structure.

Haloacetic acids (five) (HAA5): the sum of the concentrations in milligrams per liter of the haloacetic acid compounds (monochloroacetic acid, dichloroacetic acid, trichloroacetic acid, monobromoacetic acid, and dibromoacetic acid), rounded to two significant figures after addition. 40 CFR 141.2

Heterotrophic plate count (HPC): a procedure for estimating the number of heterotrophic bacteria in water, measured as the number of colony forming units per 100 mL.

Influence zone: the portions of the distribution system supplied with water from a particular source of supply.

Locational running annual average (LRAA): the average of samples taken at a particular monitoring site during the previous four calendar quarters.

Maximum contaminant level (MCL): the maximum permissable level of a contaminant in water which is delivered to any user of a public water system. 40 CFR 141.2

Maximum contaminant level goal (MCLG): the maximum level of a contaminant in drinking water at which no known or anticipated adverse effect on the health of persons would occur, and which allows an adequate margin of safety. Maximum contaminant level goals are non-enforceable health goals. 40 CFR 141.2

Mixing Zone: an area in the distribution system where water flowing from two or more different sources blend.

Monitoring site: the location where samples are collected.

Nontransient noncommunity water system (NTNCWS): a public water system that is not a community water system and that regularly serves at least 25 of the same persons over 6 months per year. 40 CFR 141.2

Noncommunity water system: a public water system that is not a community water system. 40 CFR 141.2

Public water system (PWS): a system for the provision to the public of piped water for human consumption, if such system has at least fifteen service connections or regularly serves an average of at least twenty-five individuals daily at least 60 days out of the year. Such term includes (1) any collection, treatment, storage, and distribution facilities under control of the operator of such system and used primarily in connection with such system, and (2) any collection or pretreatment storage facilities not under such control which are used primarily in connection with such system. A public water system is either a "community water system" or a "noncommunity water system." 40 CFR 141.2

Residence time: the time period lasting from when the water is treated to a particular point in the distribution system. Also referred to as water age.

Residual disinfection: also referred to as "secondary disinfection." The process whereby a disinfectant (typically CL or CLM) is added to finished water in order to maintain a disinfection residual in the distribution system.

Running annual average: the average of monthly or quarterly averages of all samples taken throughout the distribution system, as averaged over the preceding four quarters.

Service connection: as used in the definition of public water system, does not include a connection to a system that delivers water by a constructed conveyance other than a pipe if:
(1) The water is used exclusively for purposes other than residential uses (consisting of drinking, bathing, and cooking, or other similar uses);
(2) The State determines that alternative water to achieve the equivalent level of public health protection provided by the applicable national primary drinking water regulation is provided for residential or similar uses for drinking and cooking; or
(3) The State determines that the water provided for residential or similar uses for drinking, cooking, and bathing is centrally treated or treated at the point of entry by the provider, a pass-through entity, or the user to achieve the equivalent level of protection provided by the applicable national primary drinking water regulations. (From the National Primary Drinking Water Regulations, 40 CFR Ch.1, 7/1/00 Edition.)

Stage 2A: the period beginning [3 years after rule promulgation] until the dates specified for compliance with Stage 2B, during which systems must comply with Stage 2A MCLs.

Stage 2B: the period beginning [6 years after rule promulgation] for systems serving at least 10,000 people; [8.5 years after rule promulgation] for systems serving fewer than 10,000 people that are required to do *Cryptosporidium* monitoring under the Long Term 2 Enhanced Surface Water Treatment Rule (LT2ESWTR); [7.5 years after rule promulgation] for all other systems serving fewer than 10,000 people, during which systems must comply with Stage 2B MCLs.

State: the agency of the State or Tribal government which has jurisdiction over public water systems. During any period when a State or Tribal government does not have primary enforcement responsibility pursuant to section 1413 of the Act, the term "State" means the Regional Administrator, U.S. Environmental Protection Agency. 40 CFR 141.2

Subpart H systems: public water systems using surface water or ground water under the direct influence of surface water as a source that are subject to the requirements of 40 CFR 141.2 (h). 40 CFR 141.2

Surface water: all water which is open to the atmosphere and subject to surface runoff. 40 CFR 141.2

Total trihalomethanes (TTHM): the sum of the concentration in milligrams per liter of the trihalomethane compounds (trichloromethane, [chloroform], dibromochloromethane, bromodichloromethane, and tribromomethane [bromoform]), rounded to two significant figures. 40 CFR 141.2

Total chlorine residual: the sum of combined chlorine (chloramine) and free available chlorine residual.

Tracer study: a procedure for estimating hydraulic properties of the distribution system, such as residence time. Where more than one water source feeds the distribution system, tracer studies can be used to determine the zone of influence of each source.

Trihalomethane (THM): one of the family of organic compounds named as derivatives of methane, wherein three of the four hydrogen atoms in methane are each substituted by a halogen atom in the molecular structure. 40 CFR 141.2

Water distribution system model: a computer program that can simulate the hydraulic, and in some cases, water quality behavior of water in a distribution system.

Wholesale system: a public water system that treats source water and then sells or otherwise delivers finished water to another public water system for at least 60 days per year. Delivery may be through a direct connection or through the distribution system of another consecutive system. 40 CFR 141.2

1.0 Introduction

Initial Distribution System Evaluations (IDSEs), required by the Stage 2 Disinfectants and Disinfection Byproducts Rule (DBPR), are studies conducted by water systems to identify compliance monitoring sites that represent high disinfection byproduct (DBP) levels in distribution systems (40 CFR 141.600). IDSEs are based on either 1 year of monitoring or other system-specific data that provide equivalent or better information than monitoring. Systems serving fewer than 500 people can receive waivers from IDSE requirements, and systems that demonstrate historically low distribution system DBP concentrations may not have to perform an IDSE.

The Stage 2 DBPR (also referred to as "the rule") applies to all community water systems[1] (CWSs) and nontransient noncommunity water systems[2] (NTNCWSs) that add a primary or residual disinfect other than ultraviolet light (UV), or deliver water that has been treated with a primary or residual disinfectant other than UV (40 CFR 141.620(b)). IDSEs are a key part of the rule and the focus of this guidance manual. The purposes of this manual are two-fold—to provide guidance to **systems** so that they can meet IDSE requirements and provide guidance to **States**[3] in evaluating the adequacy of IDSEs.

This introductory chapter is organized as follows:

1.1 Classifying Systems for the Purposes of the IDSE
1.2 Summary of the Stage 2 DBPR
1.3 Overview of IDSE Requirements
1.4 Guidance Manual Navigation Charts

Chapters 2 through 8 of this manual describe IDSE requirements for different IDSE options and system sizes and types.

> Subsequent chapters of this manual apply to different IDSE options and system sizes and types.

Systems will not need to read every chapter of this manual—the manual is organized such that systems can refer to one or more stand-alone chapters depending on their systems' characteristics and IDSE option.

---

[1] A CWS is public water system that has at least 15 service connections used by year-round residents or regularly serves at least 25 year-round residents (40 CFR 141.2).

[2] A NTNCWS is a public water system that has at least 15 service connections or regularly serves an average of at least 25 of the same individuals for at least 6 months per year (40 CFR 141.2).

[3] Throughout this document, the terms "State" or "States" are used to refer to all types of primacy agencies, including U.S. Territories, Indian Tribes, and EPA Regions.

The manual contains the following features to guide systems to the appropriate chapters:

- The worksheet on page 1-13 will help systems classify themselves for the purposes of determining their IDSE requirements (all systems should fill out this worksheet).
- The flow chart and examples in section 1.1 will help systems determine their IDSE schedule.
- The Guidance Manual Navigation charts in section 1.4 are provided to help systems determine which IDSE option they can use to meet requirements and which chapter(s) provides more information on each option.
- Additional flow charts at the end of Chapters 4 through 7 are for those systems that conduct monitoring for an IDSE.
- Notes on the bottom of every page indicate the type and size of system to which that chapter applies.

1.1 Classifying Systems for the Purposes of the IDSE

Requirements for the IDSE (as well as requirements for Stage 2 DBPR compliance monitoring) differ by system size and type (40 CFR 141.602). For example, systems using only ground water will have different monitoring requirements than systems using surface water. Small systems may have different IDSE schedules than large systems. Before reading the rest of this manual, it is important for systems to first determine their classification so that they will understand which rule requirements apply to them.

In general, there are four main system characteristics that drive IDSE requirements:

- Source water classification (surface vs. ground)
- Buying and selling relationships with other systems (consecutive vs. wholesale)
- Size (population served)
- Number of treatment plants

Source water classification is discussed in section 1.1.1. Section 1.1.2 describes how to determine when the IDSE report is due to the State. This is important in the classification process because the IDSE schedule determines which operating year must be reviewed to determine further rule requirements (for systems that buy at least some of their water). Section 1.1.3 provides additional rule clarifications for systems that buy some or all of their water. Section 1.1.4 follows with guidance for determining the number of plants in a water system (e.g., if you buy finished water from another water system, the rule may require that interconnection to be considered a "plant"). A worksheet is provided at the end of this section to help systems determine their classifications.

1.1.1 Determining Source Water Classification

For the purposes of the IDSE and Stage 2 DBPR, systems must determine if they are a surface or ground water system.

- *Surface water systems* are the same as subpart H systems—they use surface water or ground water under the direct influence of surface water (GWUDI). Surface water systems include those that treat surface water (or GWUDI) themselves or purchase finished surface water from other systems. Surface water systems include <u>all mixed systems</u> that have both surface and ground water sources.
- *Ground water systems* are those systems that use <u>only</u> disinfected ground water (or purchased disinfected ground water).

1.1.2 Determining When an IDSE Report is Due to the State

For the purposes of this guidance manual, the **early schedule** means that systems must submit their IDSE report no later than [2 years after rule promulgation], while the **late schedule** means that systems must submit their report no later than [4 years after rule promulgation]. Table 1.1 shows which systems must conform to each schedule type.

Table 1.1 Summary of IDSE Reporting Schedules[1]

Schedule Type	Report Due Date	Applicable Systems
Early schedule	[2 years after rule promulgation]	Systems serving at least 10,000 people
		Systems serving less than 10,000 people that are part of a combined distribution system with at least one system serving 10,000 or more people
Late schedule	[4 years after rule promulgation]	Systems serving less than 10,000 people that are <u>not</u> part of a combined distribution system with at least one system serving 10,000 or more people

[1](40 CFR 141.600(c))

As indicated in the table, an IDSE report schedule is based on the population served by the largest system in the combined distribution system. Note that the schedule is based on the largest population served by a <u>single system</u> (not the sum of all system populations) in the combined distribution system. The Stage 2 DBPR defines the following terms for systems buying and selling finished water (40 CFR 141.2):

> <u>*Consecutive system*</u> - public water system that buys or otherwise receives some or all of their finished water from one or more systems for at least 60 days per year.
>
> <u>*Wholesale systems*</u> - public water system that treats source water and then sells or otherwise delivers finished water to another public water system for at least 60 days per year. Delivery may be through a direct connection or through the distribution system of one or more consecutive systems.
>
> <u>*Combined distribution system*</u> - the totality of the distribution systems of wholesale systems and of the consecutive systems that receive finished water from those wholesale systems.

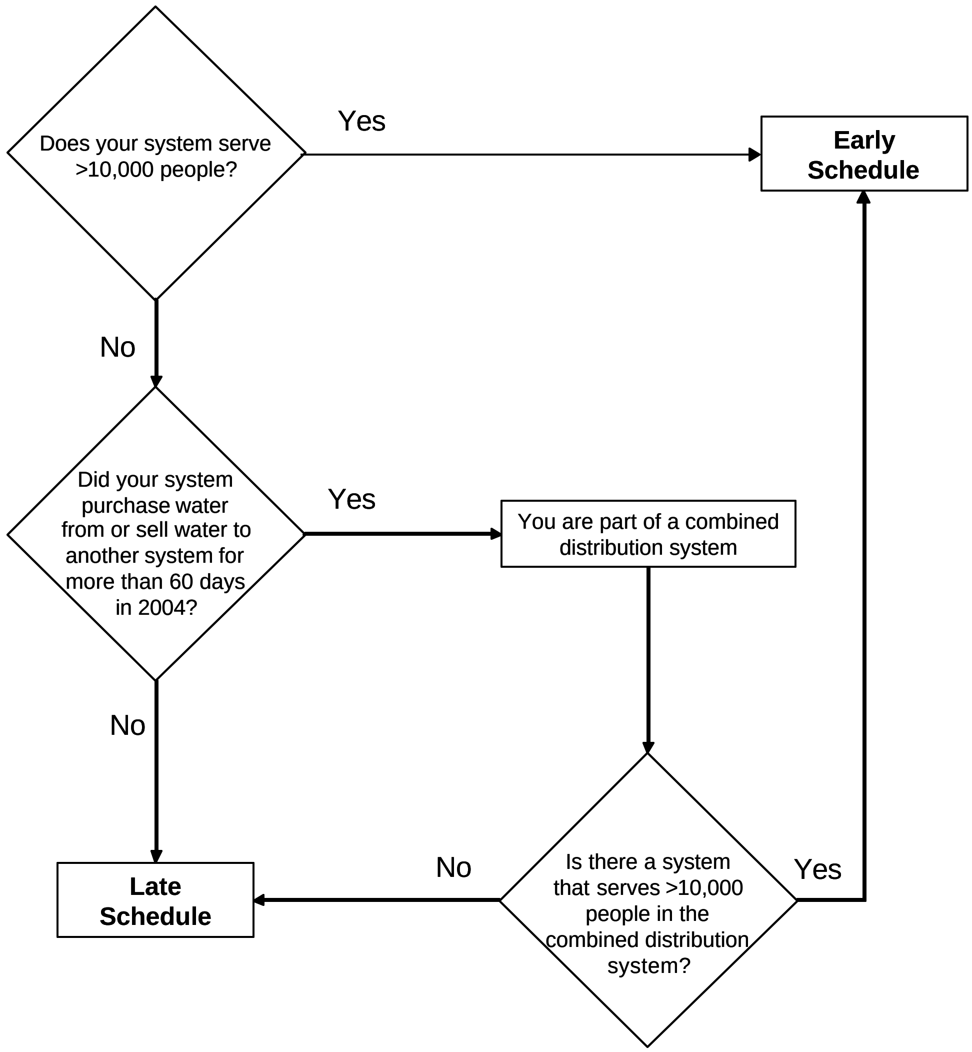
Delivery of water from a wholesale system can be through a direct connection(s) or through the distribution system of another system. For example, in a situation where system A buys water from system B who buys all their water from system C, all three systems are considered to be in the same combined distribution system.

To determine which systems are included in a combined distribution system, include only those that buy for at least **60 days per year during year 2004**.

The flow chart in Figure 1.1 can be used to determine the IDSE report schedule required for systems. Examples 1.1 through 1.3 show how the guidance is applied in specific situations. Systems that are still unclear on their IDSE report schedule after reading this section should contact their State for guidance. A worksheet for systems to complete is provided at the end of the section that also assists in determining report schedule.

EPA recommends that systems share information about their IDSE report schedule with all wholesale purchasers. Coordination with purchasing systems is not required, but is strongly recommended.

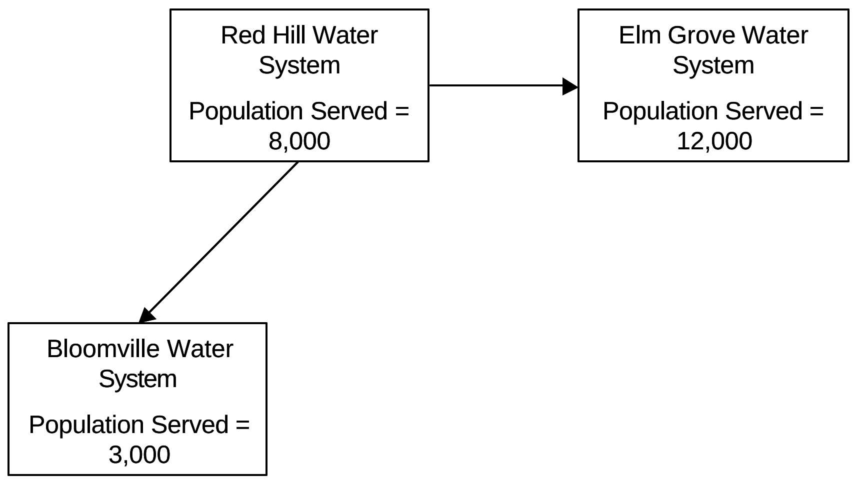
Figure 1.1 Decision Tree for Determining IDSE Reporting Schedule



*****Examples for Determining IDSE Report Schedule*****

Example 1.1—One Seller with Two Buyers

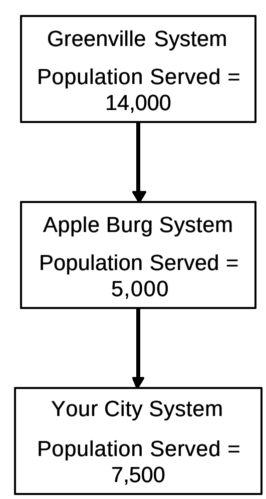
Red Hill water system sells water to both Elm Grove and Bloomville systems year- round.



Bloomville, Red Hill, and Elm Grove are all part of one combined distribution system. Because Elm Grove serves greater than 10,000 people, all three systems are on the **early schedule**.

Example 1.2— Systems with Temporary Sources

Your City purchases all of its water from nearby Apple Burg. pple Burg purchased water on an emergency basis from Greenville for less an 60 days in 2004. Because Greenville is considered a temporary (not a ermanent) source for Apple Burg, it is not considered to be part of the ame combined distribution system as Apple Burg and Your City. herefore, Your City and Apple Burg are on the **late schedule**.

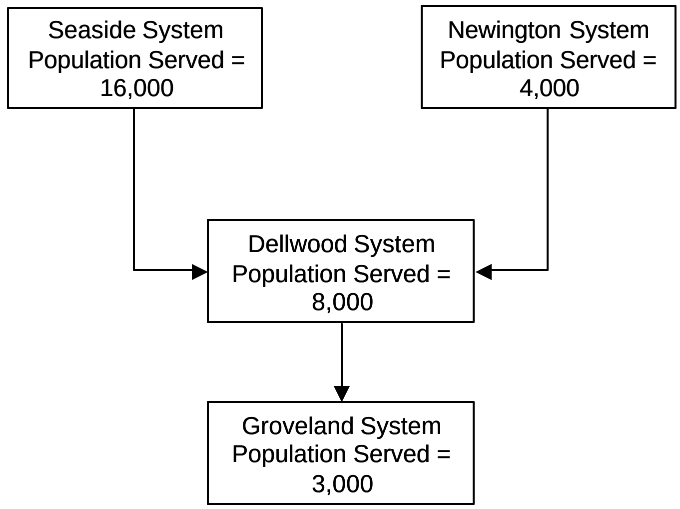


A th p s T

Example 1.3—Systems with Permanent, Seasonal Sources

Seaside system sells water for approximately **90 consecutive days** in the summer to Dellwood. Dellwood buys the remainder of its water from Newington. Groveland buys a portion of its water year-round from Dellwood.

All four systems shown are part of the same combined distribution system. Because the largest system serves 16,000 people, all systems are on the **early schedule.**



1.1.3 Buying or Treating Water

IDSE requirements differ between those system that treat some or all of their water and those that buy all of their finished water. Because the use of seasonal or emergency water can differ from year to year, the Stage 2 DBPR requires that systems evaluate operating data from the year **2004** if they are on the **early IDSE schedule** and from year **2006** if on the **late IDSE schedule** (40 CFR 141.602(d)).

Throughout this guidance manual, the terms "100 percent purchasing systems" and "producing systems" are used to differentiate between the two system types when describing IDSE requirements.

- *100 percent purchasing systems* - consecutive systems that buy or otherwise receive all of their finished water from one or more systems year-round. Systems that buy all of their finished water, but also use booster disinfection, are still considered a 100 percent purchasing systems.

- *Producing systems* - systems that do not purchase 100 percent of their finished water from other systems year-round (i.e., they have one or more non-purchased sources and produce some or all of their own finished water).

1.1.4 Number of "Plants"—Producing Systems Only

If you are a 100 percent purchasing system, you can skip this section and go directly to next section (1.2 Summary of the Stage 2 DBPR).

Monitoring requirements of the Stage 2 DBPR depend on the number of "plants" in a system for those systems that produce some or all of their own water. The rule specifies that consecutive system entry points[4] receiving water treated by a disinfectant other than UV, for at least 60 consecutive days a year, must be considered as a plant (40 CFR 141.601(d)). For the purposes of guidance the following should also be considered as a "plant":

- A facility treating a surface water source in the system.

- A facility treating (at minimum, adding a disinfectant, not including UV) a ground water source in the system.

Note, a system may be defined as a consecutive system (receiving water for at least 60 days per year) while the consecutive entry point is not considered as a plant because they do not receive water for 60 *consecutive* days.

The rule allows States to consider multiple entry points or treatment facilities as one "plant" in the following situations (40 CFR 141.601(d)):

- *Multiple Wells Drawing from the Same Aquifer*. With State approval, systems with multiple wells drawing from a single aquifer may consider those wells as one plant.

- *Multiple Consecutive Entry Points Delivering Water from One Wholesaler*. Systems with multiple consecutive entry points from the same wholesale system may consider those entry points one plant, with State approval. In these cases, the system must demonstrate that factors such as relative locations of entry points, residence times, sources, and the presence of treatment (such as corrosion control or booster disinfection) are similar and will not have a significant effect on TTHM and HAA5 formation between the entry points.

The following are instances in which treatment facilities and entry points should *not* considered a plant.

[4] A consecutive system entry point is a site at which finished water is delivered from a wholesale system to a consecutive system that buys some or all of its water, at least 60 days per year. To be considered a "plant," water must be delivered for 60 consecutive days per year.

- Booster disinfection or other satellite treatment facilities that may add disinfection to *finished* water.

- Individuals wells that feed into one entry point or treatment facility (only the one entry point would be considered a plant).

- Consecutive entry points that are used for less than 60 consecutive days per year (e.g., emergency connections).

- Interconnections that deliver untreated water.

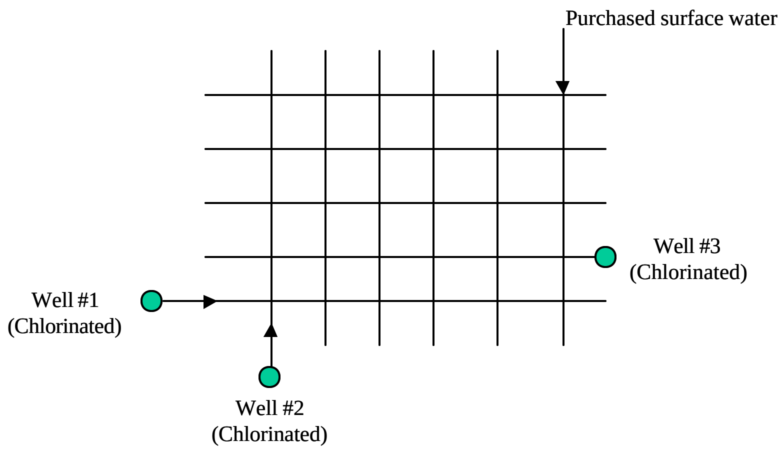
Examples 1.4 through 1.6 show how these guidelines can be used to determine the number of plants for the purposes of an IDSE.

*****Examples for Determining Number of Plants*****

Example 1.4—Multiple Wells and Purchasing Treated Water

A system purchases treated surface water year-round through one entry point, and has three wells. Chlorine is added at each well site. The State determined that two of the wells draw from the same aquifer and that the third well draws from a different aquifer.

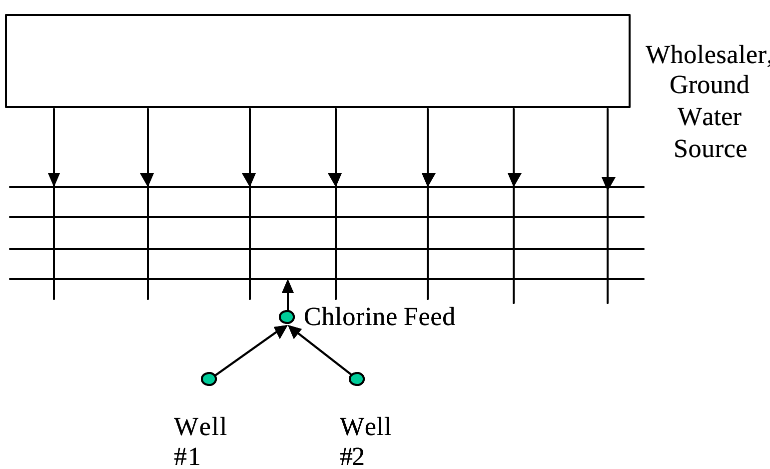
Total plants: 3 (one for the purchased water entry point, the second for the two wells drawing from the same aquifer, and the third for the well drawing from another aquifer).



Example 1.5—Multiple Consecutive Entry Points and Multiple Wells

A system purchases treated ground water from one wholesaler through five entry points and has two wells. The State has approved multiple consecutive entry points to be considered as one plant. The two wells feed into one pumphouse where chlorine is added; this is considered one treatment plant.

Total plants: 2 (one plant for the consecutive entry points and one ground water plant)



******Examples for Determining Number of Plants (continued)*****

Example 1.6—Connections Not Used Year-Round

Your City's system purchases disinfected ground water from City A year-round and has an emergency connection with City B. In the summer of 2004, City A's water supply was low, so Your City's system had to use City B intermittently from July to September. Your City reviewed its purchasing records from year 2004 and determined that you received water from City B for 72 days that year, but at most, only 45 days were consecutive.

Total plants: 1 (City A) (Although the City B connection is considered a consecutive system entry point, it is not considered a plant since Your City's system did not receive water for 60 consecutive days in year 2004).

1.1.5 System Classification Worksheet

A *system classification worksheet* is provided on the next page to help systems determine their IDSE schedule and buying/selling relationships for the purposes of determining IDSE requirements and navigating this guidance manual. ***Before using this manual, it is very important that all systems complete this worksheet.***

System Classification Worksheet

Determine System Size and Schedule

1. What is the population served by your water system?

   ≥10,000 ➜ You are a **Large System** on the **Late Schedule**. Go to #3.

   <10,000 ➜ You are a **Small System**. Go to #2.

2. Small systems (serving <10,000): Did your system buy or sell finished water for at least 60 days in the year 2004?

   No ➜ You are on the **Late Schedule**.

   Yes ➜ Is there a system that serves over 10,000 people in your combined distribution system?

      No ➜ You are on the **Late Schedule**.

      Yes ➜ You are on the **Early Schedule**.

Determine Consecutive System Status

3. Did you buy finished water for at least 60 days in 2004 (if on the Early Schedule) or 2006 (if on the Late Schedule)?

   No ➜ You are a **Producing System** (you are done with this worksheet).

   Yes ➜ You are a **Consecutive System**. Go to #4.

4. Consecutive systems: Did you buy all of your finished water in 2004 (if on the Early Schedule) or 2006 (if on the Late Schedule)?

   No ➜ You are a **Producing System**. Go to #5.

   Yes ➜ You are a **100 Percent Purchaser** (you are done with this worksheet).

5. Consecutive, producing systems: If you purchase any finished water from a wholesale system for at least 60 *consecutive* days during 2004 (if on the Early Schedule) or 2006 (if on the Late Schedule), you must treat these entry points as "plants" for the purposes of determining IDSE and Stage 2B monitoring requirements.

1.2 Summary of the Stage 2 DBPR (40 CFR 141, Subpart Q, Appendix A, 141.600, and 141.626)

The Stage 2 DBPR applies to all CWSs and NTNCWSs that add a primary or residual disinfectant other than UV, or deliver water that has been treated with a disinfectant other than UV. The compliance determination and schedule, compliance monitoring, and significant excursion requirements for the Stage 2 DBPR are discussed below. Section 1.3 provides a more detailed description of IDSE provisions.

Purpose

As Stated in the Stage 2 Microbial and DBP Agreement in Principle, "The Stage 2 DBPR is designed to reduce DBP occurrence peaks in the distribution system based on changes to compliance monitoring provisions. Compliance monitoring will be preceded by an IDSE study to select site-specific optimal sample points for capturing peaks."[5]

Compliance Determination and Schedule

Compliance determination for the Stage 2 DBPR is based on a locational running annual average (LRAA) of total trihalomethanes (TTHM) and five haloacetic acids (HAA5) concentrations. Compliance must be met at *each* monitoring location, instead of system-wide using the running annual average (RAA) used under the Stage 1 DBPR.

The rule will be implemented in two stages:

Stage 2A: Starting [3 years after rule promulgation],[6] all systems must comply with TTHM/HAA5 maximum contaminant levels (MCLs) of 120/100 micrograms per liter (µg/L)[7], measured as LRAAs at each Stage 1 DBPR compliance monitoring site and continue to comply with the Stage 1 DBPR MCLs of 80/60 µg/L measured as RAAs.

Stage 2B: Beginning in [6 years after rule promulgation], systems serving at least 10,000 people must comply with TTHM/HAA5 MCLs of 80/60 µg/L measured as LRAAs at the monitoring sites identified in the IDSE report. For systems serving fewer than 10,000 people that are

[5] U.S. Environmental Protection Agency. 2000. *Stage 2 M-DBP Agreement in Principle*. Microbial/Disinfection Byproducts (M-DBP) Federal Advisory Committee. Signed September 12, 2000. *Federal Register* 65(251):83015-83024.

[6] Actual compliance dates to be provided in future drafts.

[7] Although MCLs are Stated in milligrams per liter (mg/L) in the Stage 2 DBPR rule language, they are presented as µg/L to be consistent with terminology in the rest of this guidance manual.

required to do *Cryptosporidium* monitoring under the Long Term 2 Enhanced Surface Water Treatment Rule (LT2ESWTR), compliance with the 80/60 µg/L MCLs measured as LRAAs will begin [8.5 years after rule promulgation]. For all other systems serving fewer than 10,000 people, compliance with the 80/60 µg/L MCLs measured as LRAAs will begin [7.5 years after rule promulgation]. States may grant up to a 2-year extension if capital improvements are required by a system to comply with the MCLs.

Compliance Monitoring

Systems will continue to monitor at their Stage 1 DBPR compliance monitoring locations during Stage 2A. For Stage 2B, EPA has developed different compliance monitoring approaches depending on the system's buying and selling relationships with other systems:

- **A plant-based approach** for **producing systems** that is dependent on population served, source water, AND the number of plants in a system (as with Stage 1 DBPR compliance monitoring) and applies to systems that produce some or all of their own finished water. For the purpose of the Stage 2 DBPR, a plant can be either a treatment plant (that provides, at a minimum, disinfection using a disinfectant other than UV) or a consecutive system entry point that operates for at least 60 consecutive days per year.

- **A population-based approach** for **100 percent purchasing systems** that is dependent on population served and source water and applies to only those systems that purchase 100 percent of their finished water from other systems.

Tables 1.2 and 1.3 summarize Stage 2B compliance monitoring requirements for producing systems (plant-based approach) and 100 percent purchasing systems (population-based approach), respectively.

Changes in the total number of samples collected per year from the Stage 1 to the Stage 2 DBPR will be minor for most producing systems. The type of samples, however, will change for most systems. For 100 percent purchasing systems, the change in monitoring from the Stage 1 to the Stage 2 DBPR will vary from system to system depending on the number of plants.

Significant Excursion Evaluations

Because Stage 2 DBPR MCL compliance is based on an annual average of DBP measurements at a given location, a system could from time to time have DBP levels significantly higher than the MCL while still being in compliance. This is because high concentrations could be averaged with lower concentrations at a given location. The Stage 2 DBPR requires States to develop a procedure for identifying significant DBP excursions as a special primacy condition. If a significant excursion occurs, a system must conduct a significant excursion evaluation and discuss the evaluation with the State no later than the next sanitary survey. Significant excursion evaluations are **not** covered in this manual. EPA is developing a separate guidance manual to address significant excursion evaluations.

Table 1.2 Stage 2B Plant-based Compliance Monitoring Requirements for Producing Systems[1,2]

System Size (Population Served[3])	Number of Distribution System Sites (by location type) per Plant[4]			Total Number of Sites per Plant	Monitoring Frequency[5]
	Stage 1 Average Residence Time Site	Highest TTHM	Highest HAA5		
Surface Water Systems[6]					
< 500	-	1	1	**2**[7]	Every 365 days
500 - 9,999	-	1	1	**2**	Every 90 days
$\geq$ 10,000	1	2	1	**4**	Every 90 days
Ground Water Systems					
< 500	-	1	1	**2**[7]	Every 365 days
500 - 9,999	-	1	1	**2**	Every 365 days
$\geq$ 10,000	-	1	1	**2**	Every 90 days

1 (40 CFR 141.605 (a))

2 For the purpose of this guidance manual, *producing systems* are those that do not buy 100 percent of their water year-round (i.e., they produce some or all of their own finished water).

3 *Population served* is typically a system's retail population. It should not include populations served by consecutive systems that purchase water from that system.

4 For the purposes of the Stage 2 DBPR compliance monitoring, a consecutive system entry point that operates for at least 60 consecutive days per year must be considered a plant (40 CFR 141.601(d)).

5 Monitoring frequency is the approximate number of days between monitoring events. A dual sample set must be collected at each location, unless otherwise noted. A dual sample set is one TTHM and one HAA5 sample that is taken at the same time and location.

6 For the purpose of this guidance manual, "surface water systems" are equivalent to subpart H systems (i.e., any system that uses surface water or GWUDI as a source, including all mixed systems that use some surface water or GWUDI and some ground water).

7 Dual sample sets are not required at both the high TTHM and the high HAA5 site—if the highest TTHM and HAA5 levels occur at a different location, then only one sample is collected at each location. If they occur at the same location, then a dual sample set is collected at that location.

The number of compliance monitoring sites presented in Table 1.2 are **per plant**.

Table 1.3 Stage 2B Population-based Compliance Monitoring Requirements for 100 Percent Purchasing Systems[1,2]

System Size (Population Served[3])	Number of Distribution System Sites (by location type) per System			Total Number of Sites per System	Monitoring Frequency[4]
	Stage 1 Average Residence Time Site	Highest TTHM	Highest HAA5		
Surface Water Systems[5]					
< 500	-	1	1	**2**[6]	Every 365 days
500 - 4,999	-	1	1	**2**[6]	Every 90 days
5,000 - 9,999	-	1	1	**2**	Every 90 days
10,000 - 24,999	1	2	1	**4**	Every 90 days
25,000 - 49,999	1	3	2	**6**	Every 90 days
50,000 - 99,999	2	4	2	**8**	Every 90 days
100,000 - 499,999	3	6	3	**12**	Every 90 days
500,000 - 1,499,999	4	8	4	**16**	Every 90 days
1.5 million - < 5 million	5	10	5	**20**	Every 90 days
≥ 5 million	6	12	6	**24**	Every 90 days
Ground Water Systems					
< 500	-	1	1	**2**[6]	Every 365 days
500 - 9,999	-	1	1	**2**	Every 365 days
10,000 - 99,999	1	2	1	**4**	Every 90 days
100,000 - 499,999	1	3	2	**6**	Every 90 days
≥ 500,000	2	4	2	**8**	Every 90 days

1 (40 CFR 141.605 (e))

2 For the purpose of this guidance manual, *100 percent purchasing systems* are those systems that buy or otherwise receive all of their finished water from one or more wholesale systems year-round.

3 *Population served* is typically a system's retail population. It should not include populations served by consecutive systems that purchase water from that system.

4 Monitoring frequency is the approximate number of days between monitoring events. A dual sample set must be collected at each location, unless otherwise noted. A dual sample set is one TTHM and one HAA5 sample that is taken at the same time and location.

5 For the purpose of this guidance manual, "surface water systems" are equivalent to subpart H systems (i.e., any system that uses surface water or GWUDI as a source, including all mixed systems that use some surface water or GWUDI and some ground water).

6 Dual sample sets are not required at both the high TTHM and the high HAA5 site—if the highest TTHM and HAA5 levels occur at a different location, then only one sample is collected at each location. If they occur at the same location, then a dual sample set is collected at that location.

The number of compliance monitoring sites presented in Table 1.3 are **per system**.

1.3 Overview of IDSE Requirements (40 CFR 141.600-604)

This section provides a brief overview of IDSE requirements. Other sections of this manual that provide more detailed information and guidance are referenced.

1.3.1 Purpose

The Stage 2 DBPR requires monitoring at sites that represent the areas of high DBP levels in the distribution system, which differs from Stage 1 DBPR site requirements. The existing Stage 1 DBPR monitoring site requirements are based on residence time only. Other factors contribute to DBP formation, particularly for HAAs, that can cause higher DBP concentrations in areas not represented by Stage 1 sites. Additionally, for surface water systems, the Stage 1 DBPR requires only one of four monitoring sites per plant at a maximum residence time location and three sites at average residence time locations. Generally, high DBPs occur in areas of higher residence time and a well-maintained residual disinfectant.

The purpose of the IDSE is to identify areas in the distribution system with representative high DBP concentrations. The purpose of the IDSE is *not* to identify the peak daily or hourly DBP concentrations that occur in a distribution system, but instead, to find areas with routinely higher DBP concentrations than other locations. As discussed later in this manual, systems will select compliance monitoring sites based on *annual averages* of DBP data at selected sites, not the results of individual sampling events.

1.3.2 Applicability

IDSE requirements of the Stage 2 DBPR apply to all CWSs that add a primary or residual disinfectant other than UV to their water and consecutive CWSs that deliver water that has been treated with a primary or residual disinfectant other than UV. The same requirements apply to NTNCWSs *except* those that serve fewer than 10,000 people—these systems are *not* required to perform an IDSE.

1.3.3 IDSE Options

This section provides a brief summary of waivers and certifications for systems not performing an IDSE, as well as options available for systems that must perform an IDSE. The first guidance manual navigation chart in section 1.6 directs readers to other chapters of this manual for guidance on determining the appropriate IDSE option for a specific system.

The systems that do not have to perform an IDSE are described below.

- **NTNCWSs serving fewer than 10,000 people** do *not* have to meet the IDSE provisions of the Stage 2 DBPR and do *not* have to perform an IDSE.

- States can grant **very small system waivers** to systems serving fewer than 500 people if the State determines that the Stage 1 DBPR compliance monitoring site represents both high TTHM and high HAA5 concentrations.

- Systems can qualify for the **40/30 certification**. Systems that can certify all TTHM and HAA5 compliance data are less than or equal to 40 µg/L for TTHM and 30 µg/L for HAA5 are not required to perform an IDSE.

Systems not performing an IDSE may still need to add a monitoring site to meet the requirements of the Stage 2B (selecting Stage 2B monitoring sites are addressed in other chapters of this manual - see section1.6 for the guidance manual navigation chart for IDSE options).

For systems performing an IDSE, there are two options:

- Conduct a **System-Specific Study (SSS)**. The purpose of an SSS is to evaluate DBP concentrations throughout the distribution system using an existing data source or combinations of data sources. Possible data sources include: historical DBP and disinfectant residual data, water distribution system modeling, and tracer studies.

- Complete the **Standard Monitoring Program (SMP)**. The SMP entails 1 year of distribution system monitoring. The minimum number of sample locations required and sampling frequency depend on system characteristics such as size, source water type, and number of plants (for some systems).

The SMP option for an IDSE is the default—if a system does not qualify for a waiver and does not meet the requirements for or choose to complete an SSS, they must conduct monitoring under the SMP.

1.3.4 IDSE Reporting and Recordkeeping

IDSE reporting requirements depend on the IDSE option used by the system. The following options require an IDSE report to be submitted to the State:

- 40/30 certification

- SSS
- SMP

Systems receiving a very small system waiver do <u>not</u> need to submit an IDSE report.

Minimum report contents for each option are addressed later in this manual (see section1.6 for guidance manual navigation charts for IDSE options). The schedule for submitting reports to the State does not depend on the IDSE option, but is based on system size and buying and selling relationships with other systems as follows:

- Large systems (serving at least 10,000 people) or systems with a large system in their combined distribution system must submit their report [2 years after rule promulgation].
- All other systems must submit their report [4 years after rule promulgation].

Section 1.4 provides detailed guidance for identifying systems in a combined distribution system and determining an IDSE report due date.

Systems must keep a complete copy of the submitted IDSE report for 10 years after the initial submission date. The reports must also be available for review by the State or public during this time.

1.3.5 IDSE Standard Monitoring Program Requirements

As with Stage 2B compliance monitoring, there are two regulatory approaches to an IDSE SMP[8]:

- **A plant-based approach** for **producing systems** that is dependent on source water type, population served, AND number of plants in a system (consistent with Stage 1 DBPR compliance monitoring). This approach applies to systems that produce some or all of their own finished water.
- **A population-based approach** for **100 percent purchasing systems** that is dependent on source water type, population served, and applies to only those systems that purchase 100 percent of their finished water from other systems.

---

[8]EPA is considering an alternative to the Stage 2 DBPR whereby the population-based approach would apply to ALL systems for IDSE and Stage 2B monitoring. Appendix A describes the possible impacts on systems and implications for this guidance manual of this alternative

Tables 1.4 and 1.5 summarize an IDSE SMP compliance requirements for producing systems and 100 percent purchasing systems, respectively. Note that the TTHM and HAA5 results from the IDSE SMP are not to be used in compliance calculations for the Stage 1 or Stage 2A.

Table 1.4 IDSE SMP Requirements for Producing Systems[1,2]

System Size (Population Served[3])	Residual Disinfectant	Number of Distribution System Sites (by location type) per Plant				Total Number of Sites per Plant	Monitoring Frequency[4]
		Near Entry Point	Average Residence Time	High TTHM	High HAA5		
Surface Water Systems[5]							
< 500	Chlorine or Chloramines	-	-	1	1	**2**	Every 180 days
500 - 9,999	Chlorine or Chloramines	-	-	1	1	**2**	Every 90 days
≥ 10,000	Chlorine	1	2	3	2	**8**	Every 60 days
	Chloramines	2	2	2	2	**8**	
Ground Water Systems							
< 10,000	Chlorine or Chloramines	-	-	1	1	**2**	Every 180 days
≥ 10,000	Chlorine or Chloramines	-	-	1	1	**2**	Every 90 days

1 (40 CFR 141.602(a))
2 For the purpose of this guidance manual, *producing systems* are those that do not buy 100 percent of their water year-round (i.e., they produce some or all of their own finished water).
3 *Population served* is usually a system's residential population. It does not include populations served by consecutive systems that purchase water from that system.
4 Monitoring frequency is the approximate number of days between monitoring events. A dual sample set must be collected at each location. A dual sample set is one TTHM and one HAA5 sample that is taken at the same time and location.
5 For the purpose of this guidance manual, "surface water systems" are equivalent to subpart H systems (i.e., any system that uses surface water or GWUDI as a source, including all mixed systems that use some surface water or GWUDI and some ground water).

The number of SMP sites presented in Table 1.4 are **per plant**.

Table 1.5 IDSE SMP Requirements for 100 Percent Purchasing Systems[1,2]

System Size (Population Served[3])	Number of Distribution System Sites (by location type) per System				Total Number of Sites per System	Monitoring Frequency for the 1-year IDSE Period[5]
	Near Entry Point[4]	Average Residence Time	High TTHM	High HAA5		
Surface Water Systems[6]						
< 500	-	-	1	1	**2**	Every 180 days
500 - 4,999	-	-	1	1	**2**	Every 90 days
5,000 - 9,999	-	1	2	1	**4**	Every 90 days
10,000 - 24,999	1	2	3	2	**8**	Every 60 days
25,000 - 49,999	2	3	4	3	**12**	Every 60 days
50,000 - 99,999	3	4	5	4	**16**	Every 60 days
100,000 - 499,999	4	6	8	6	**24**	Every 60 days
500,000 - < 1.5 million	6	8	10	8	**32**	Every 60 days
1.5 million - < 5 million	8	10	12	10	**40**	Every 60 days
≥ 5 million	10	12	14	12	**48**	Every 60 days
Ground Water Systems						
< 500	-	-	1	1	**2**	Every 180 days
500 - 9,999	-	-	1	1	**2**	Every 90 days
10,000 - 99,999	1	1	2	2	**6**	Every 90 days
100,000 - 499,999	1	1	3	3	**8**	Every 90 days
≥ 500,000	2	2	4	4	**12**	Every 90 days

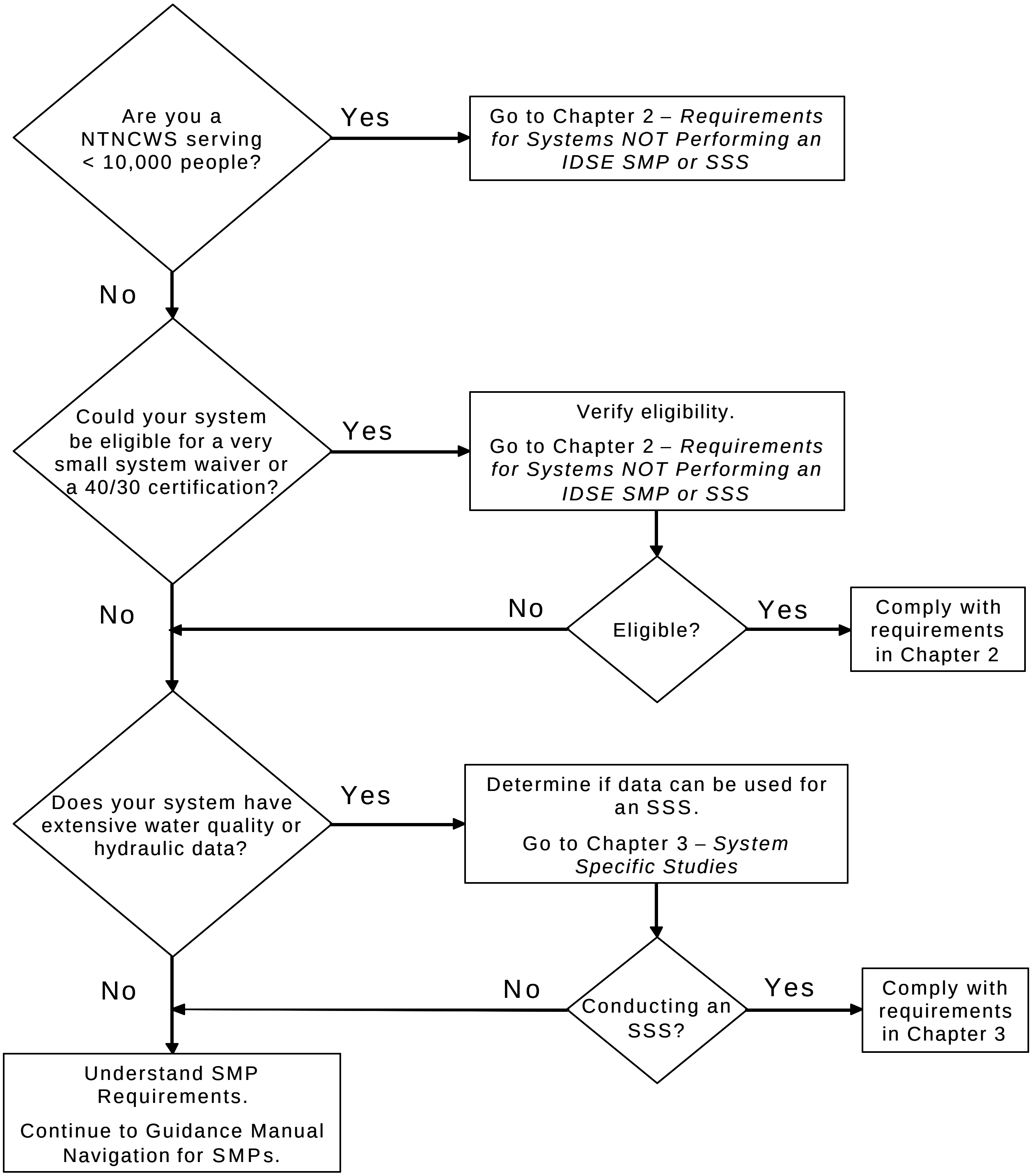
1 (40 CFR 141.602 (b))
2 For the purposes of this manual, *100 percent purchasing systems* are those systems that buy or otherwise receive all of their finished water from one or more wholesale systems year-round.
3 *Population served* is usually a system's residential population. It does not include populations served by consecutive systems that purchase water from that system.
4 See section 8.2 for requirements when the number of entry points in a system is different from the number of required near-entry point sites in this table.
5 Monitoring frequency is the approximate number of days between monitoring events. A dual sample set must be collected at each location. A dual sample set is one TTHM and one HAA5 sample that is taken at the same time and location.
6 For the purpose of this guidance manual, "surface water systems" are equivalent to subpart H systems (i.e., any system that uses surface water or GWUDI as a source, including all mixed systems that use some surface water or GWUDI and some ground water).

The number of SMP sites presented in Table 1.5 are **per system**.

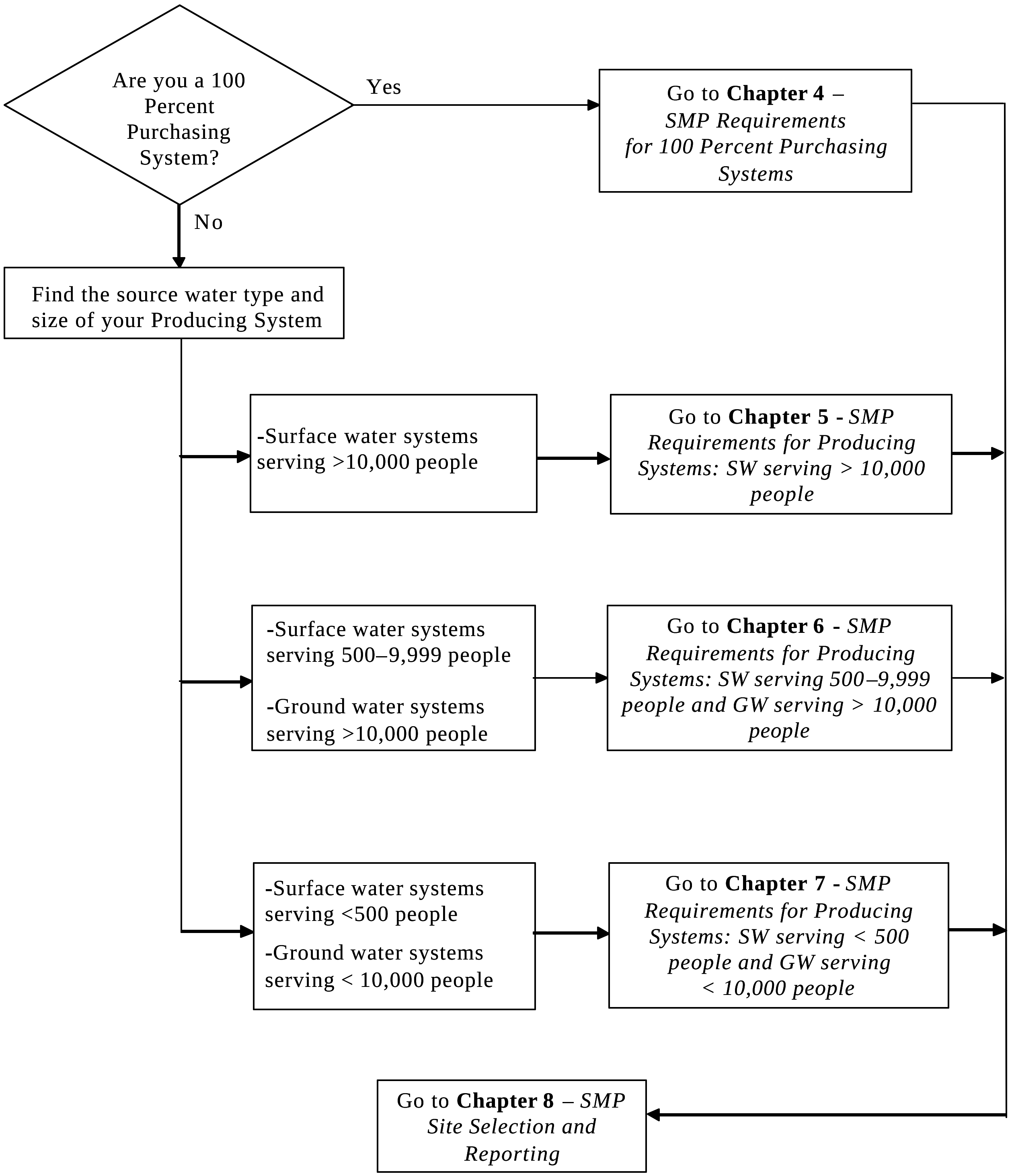
1.4 Guidance Manual Navigation Charts

The guidance manual navigation flow charts in this section will help guide readers to the appropriate section or chapter(s).

Guidance Manual Navigation for IDSE Options



Guidance Manual Navigation for SMPs[1]



[1] Use System Classification Worksheet to determine whether you are a 100% purchasing or producing system and whether you are a ground or surface water system.

2.0 Requirements for Systems NOT Conducting an IDSE SMP or SSS

2.1 Introduction

Systems are NOT required to conduct the IDSE system-specific study (SSS) or standard monitoring program (SMP) if (40 CFR 141.600(b)):

1) They are a nontransient noncommunity water system (NTNCWS) serving less than 10,000 people.

2) They receive a very small system waiver from the State. States can grant very small system waivers to systems serving less than 500 people if they determine that the Stage 1 Disinfectants and Disinfection Byproducts Rule (DBPR) compliance monitoring site represents both high total trihalomethane (TTHM) and high five haloacetic acids (HAA5) concentrations.

3) They qualify for the 40/30 certification. Any system can "opt out" of the IDSE if they certify that all compliance monitoring data are less than or equal to 40 µg/L for TTHM and 30 µg/L for HAA5.

Even if they do not perform the IDSE, systems that purchase 100 percent of their finished water[1] may have to add or be able to remove compliance monitoring sites from their existing Stage 1 DBPR compliance locations to meet the requirements of the Stage 2 DBPR.

This chapter addresses requirements for those systems not conducting an IDSE SSS or SMP and is organized as follows:

2.2 Criteria for Receiving a Very Small System Waiver
2.3 Criteria for Qualifying for the 40/30 Certification
2.4 Selecting Stage 2B Compliance Monitoring Sites
2.5 Reporting Requirements

[1] For the purposes of this manual, *100 percent purchasing systems* are those systems that buy or otherwise receive all of their finished water from one or more wholesale systems year-round. *Producing systems* are those that do not buy 100 percent of their water year-round (i.e., they produce some or all of their own finished water). See Chapter 1 for additional guidance on classifying systems.

2.2 Criteria for Receiving a Very Small System Waiver

Systems serving fewer than 500 people are eligible for an IDSE waiver if the State determines that the Stage 1 DBPR monitoring site (the location of maximum residence time in the distribution system) represents the highest concentration for both TTHM and HAA5 (40 CFR 141.603). This will often be the case—both TTHM and HAA5 tend to continue to form in drinking water as long as disinfectant residuals and DBP precursors are present. Unlike TTHM, however, HAA5 is known to biodegrade when disinfectant residuals are low (see Appendix B for additional information of HAA5 formation and biodegredation). Below are some system conditions that indicate that the highest TTHM and HAA5 concentrations may **not** occur at the same location:

- <u>Inability to maintain a disinfectant residual in all parts of the system</u>. Areas with very low or no disinfectant residual can have long residence times and may have some biological activity. These areas may have high TTHM concentrations due to long residence time, but have less-than-maximum HAA5 concentrations due to biodegradation in the distribution system.

- <u>High levels of heterotrophic bacteria (if data are available)</u>. Elevated levels of heterotrophic bacteria in the distribution system (especially if they occur repeatedly) may reflect environmental conditions that promote biofilm growth and, thus, have the potential for HAA5 biodegradation.

- <u>TTHM concentration much greater than HAA5 concentration</u> at the Stage 1 DBPR monitoring site (possibly indicating degradation of HAA5 in the sample location area). As a rule of thumb, EPA recommends that systems consider selecting a different monitoring site to represent high HAA5 if their Stage 1 DBPR TTHM data are, on average, more than <u>4 times</u> greater than Stage 1 DBPR HAA5 data.[2]

These guidelines are not all-inclusive—TTHM and HAA5 formation depends on many system-specific factors.

States should notify systems serving less than 500 people as to their waiver status. If the highest TTHM and HAA5 concentrations **do not** occur at the same location and the State does not grant the waiver, systems must perform an IDSE. See Chapter 4 for SMP requirements for 100 percent purchasing systems and Chapter 7 for SMP requirements for producing systems serving less than 500 people.

[2] This rule of thumb is based on analysis of TTHM and HAA5 data collected under the Information Collection Rule (ICR).

2.3 Criteria for Qualifying for the 40/30 Certification

Systems demonstrating low historic TTHM and HAA5 distribution system concentrations in accordance with the Stage 2 DBPR requirements may qualify for the 40/30 certification. Systems must meet the following to qualify (40 CFR 141.603(b)):

- All individual TTHM compliance data must be less than or equal to 40 µg/L and all individual HAA5 compliance data must be less than or equal to 30 µg/L during the periods specified in Table 2.1.

- No TTHM or HAA5 monitoring violations during the period specified in Table 2.1

- All monitoring data must have been analyzed by a certified laboratory (per Stage 1 DBPR compliance monitoring requirements).

Consecutive systems that did not take the number of samples required of its size and source water type under the Stage 1 DBPR, are not eligible for the 40/30 certification (40 CFR 141.601(a)). The Stage 1 DBPR allowed the State to allocate sample sites across a combined distribution system at their discretion. As a result, some systems may have few or no sample sites and thus insufficient data to support a 40/30 certification.

Table 2.1 Compliance Monitoring Data Requirements for the 40/30 Certification[1]

Source Water Type	Population Served[2]	Regulation and Monitoring Period[3]
Surface water[4]	≥10,000 people	Stage 1 DBPR compliance data from January 2002 to December 2003
	< 10,000 people that have a system serving ≥ 10,000 people in their combined distribution system[5]	Stage 1 DBPR compliance data collected in 2004
	<10,000 people that do not have a system serving ≥ 10,000 people in their combined distribution system[5]	Stage 1 DBPR compliance data from January 2004 to December 2005
Ground water	≥10,000 people	TTHM Rule compliance data from 2003 and Stage 1 DBPR compliance collected in 2004
	< 10,000 people that have a system serving ≥ 10,000 people in their combined distribution system[5]	Stage 1 DBPR compliance data collected in 2004
	< 10,000 people that do not have a system serving ≥ 10,000 people in their combined distribution system[5]	Stage 1 DBPR compliance data from January 2004 to December 2005

[1] 40 CFR 141.603(b).
[2] *Population served* is usually a system's retail population. It should not include populations served by consecutive systems that purchase water from that system.
[3] All data must have been analyzed by a certified laboratory and done by approved methods (as required by the Stage 1 DBPR). In addition, systems must not have had any TTHM or HAA5 monitoring violations during the period specified.
[4] For the purpose of this guidance manual, "surface water systems" are equivalent to subpart H systems (i.e., any system that uses surface water or GWUDI as a source, including all mixed systems that use some surface water or GWUDI and some ground water).
[5] A combined distribution system is the totality of the distribution system of all wholesale systems and the consecutive systems that receive finished water from the wholesale systems. See section 1.1 for guidance in identifying the largest system in a combined distribution system.

2.4 Selecting Stage 2B Compliance Monitoring Sites

NTNCWSs Serving < 10,000 People and CWSs Receiving Very Small System Waivers (40 CFR 141.601(a))

All NTNCWSs serving less than 10,000 people and CWSs receiving a very small system waiver must continue to use their Stage 1 DBPR monitoring location for the Stage 2B. In addition, samples must be collected during the same month as used for compliance under the Stage 1 DBPR.

Systems Qualifying for the 40/30 Certification (40 CFR 141.605(c))

Producing systems that qualify for the 40/30 certification may continue using their Stage 1 DBPR monitoring locations *or* may select different Stage 2B monitoring sites that better represent high TTHM and HAA5 concentrations. New sites should represent water with long residence times and detectable disinfectant residual concentrations. Systems must always retain the Stage 1 DBPR monitoring locations with the highest TTHM and HAA5 annual average concentrations. If there are site changes, the rationale must be included in the IDSE report (see section 2.5 for reporting requirements for systems that qualify for the 40/30 certification).

For 100 percent purchasing systems that qualify for the 40/30 certification, there may be a change in the required number of monitoring sites as these systems move from a plant-based (under Stage 1 DBPR) to a population-based monitoring approach under the Stage 2 DBPR. These systems may be required to select *more* Stage 2B monitoring locations if more sites are required under Stage 2B than were required under Stage 1. Similarly, if fewer monitoring sites are required under Stage 2B compared to Stage 1, then systems are permitted to "drop" monitoring locations.

Sections 2.4.1 and 2.4.2 describe the protocol for adding and dropping sites, respectively. Examples 2.1 and 2.2 that follow illustrate this protocol.

2.4.1 Protocol for *Adding* Stage 2B Compliance Monitoring Sites

When additional Stage 2B sites are required, they should be selected in the following order: maximum residence time site followed by an average residence time site. If a system is required to add more than two sites, additional sites should be added in the same order. Chapter 8 provides guidance for identifying maximum and average residence time locations.

100% Purchasing Systems

Add Stage 2B sites in the following order:

1) Maximum residence time
2) Average residence time

Repeat if more than two sites are required.

2.4.2 Protocol for *Dropping* Stage 1 Compliance Monitoring Locations

When fewer sites are required for Stage 2B than are required for Stage 1 DBPR, compliance monitoring locations may be dropped based on Stage 1 DBPR monitoring results. Sites should be dropped according to the lowest annual average TTHM concentration (provided these locations are not the highest HAA5 sites).

*****Examples for Adding and Dropping Compliance Monitoring Sites*****

Example 2.1–Adding Sites

A 100 percent purchasing surface water system serving 85,000 people can qualify for the 40/30 certification. This system has one consecutive system entry point and was required to have 4 compliance monitoring sites for the Stage 1 DBPR. For the Stage 2 DBPR, this system must have 8 compliance monitoring sites. This system must <u>ADD 4 sites</u> to its existing Stage 1 DBPR monitoring sites to meet the Stage 2 DBPR requirements. The 4 sites must be as follows: 2 maximum residence time sites and 2 average residence time sites.

Example 2.2–Dropping Sites

A 100 percent purchasing surface water system serving 12,000 people can qualify for the 40/30 certification. This system has 2 consecutive system entry points from 2 different wholesale systems and was required to have 8 sites under the Stage 1 DBPR. For the Stage 2 DBPR, this system is required to have a total of 6 compliance monitoring sites. Thus, this system can <u>DROP 2 sites</u> from its existing Stage 1 DBPR compliance monitoring sites to meet the Stage 2 DBPR requirements. The 2 sites must be as follows: 2 sites with lowest annual average TTHM concentration (as long as these sites do not have the maximum annual average HAA5

2.5 Reporting Requirements

The following systems DO NOT have to submit IDSE reports to their States:

1) NTNCWS serving less than 10,000 people.

2) Systems receiving a very small system waiver from the State.

Systems qualifying for the 40/30 certification, however, MUST complete an IDSE report and submit it to their State (40 CFR 141.604(b)). See section 1.1 to determine if your system is on the *Early Schedule* and must submit your report by [2 years after rule promulgation] or the *Late Schedule* and must submit your report by [4 years after rule promulgation].

At minimum, the IDSE report for the 40/30 certification must include (40 CFR 141.604(b) and (c)):

- All TTHM and HAA5 analytical results from compliance monitoring used to qualify for the 40/30 certification

- A schematic of the distribution system with results, location, and date of all compliance samples noted

- Proposed month(s) of monitoring for Stage 2B—schedule must include peak historical month for TTHM and HAA5 concentrations, unless the State approves another month (40 CFR 141.605(f))

- For systems that decide NOT to use one or more of their Stage 1 DBPR sites for Stage 2B compliance monitoring, the location(s) of and rationale for selecting the new site(s)

- For 100 percent purchasing systems that must add a site, the location of additional Stage 2B compliance monitoring sites

3.0 System-Specific Studies

3.1 Introduction

A System-Specific Study (SSS), like the Standard Monitoring Program (SMP) described in Chapters 4 through 7, evaluates total trihalomethane (TTHM) and five haloacetic acid (HAA5) levels throughout the distribution system. An SSS uses historical data, distribution system models, or other analyses as the basis to select Stage 2B compliance monitoring sites.

To ensure an SSS evaluates and characterizes TTHM and HAA5 formation throughout the distribution system to the extent required for the IDSE, the study must provide *equivalent or superior data for the selection* of new Stage 2B compliance monitoring sites compared to an SMP (40 CFR 141.603). The SSS option allows systems with extensive historical disinfection byproduct (DBP) and other water quality data, previous pertinent studies, or other detailed knowledge of the distribution system operations to use these resources as the basis for choosing new monitoring sites. Conducting an SSS can also allow a system to avoid the duplication of DBP field monitoring efforts if significant TTHM and HAA5 monitoring, in addition to the Stage 1 DBPR requirements, has been performed in the past. The development of *new* detailed and expensive studies is neither intended nor required.

> The SSS must provide **equivalent** or **superior** data for selection of Stage 2B sites compared to selection of sites resulting from an SMP (40 CFR 141.603).

This chapter describes two approaches to completing an SSS:

1) The use of historical TTHM and HAA5 data that are equivalent or superior to data that would be obtained under the IDSE SMP.

2) The use of a calibrated water distribution system hydraulic model and at least one round of new sampling conducted during the month of peak historical TTHM levels (or the month of peak distribution system water temperature if peak TTHM data are not available).

EPA recognizes that there are other combinations of data and system analyses that may provide equivalent or superior selection of Stage 2B compliance sites (a few alternative SSSs are discussed later in this chapter). Final approval of an SSS is dependent on the State—the approaches described here are only guidance.

This chapter focuses on requirements and general guidelines for completing an SSS using historical data or a water distribution system model. It also describes how systems can use results of their SSSs to select final Stage 2B monitoring sites and report results and final site selection to their States.

The remainder of this chapter is organized as follows:

3.2 Schedule for an SSS
3.3 SSS Using Historical Data
3.4 SSS Using a Water Distribution System Model
3.5 Alternative SSSs
3.6 Selecting Stage 2B Compliance Monitoring Sites Using SSS Results
3.7 Reporting Results to the State

3.2 Schedule for an SSS

The rule requires systems to submit their IDSE report [2 years after rule promulgation] if they are on the **early schedule**, or [4 years after rule promulgation] if they are on the **late schedule** (40 CFR 141.600(c)). The schedule is based on the population of the largest system in the combined distribution system.[1] See section 1.4 for guidance on determining whether a system is on the large or small system schedule.

Systems on the early schedule will have to decide whether to conduct an SSS or SMP *before* States are expected to receive primacy for the Stage 2 DBPR. Therefore, States will generally not be able to formally approve or accept the use of an SSS prior to the time when SMP field sampling should begin. This guidance manual contains criteria that States may use to evaluate the system-specific study. Systems should carefully consider the data and information sources available for completing an SSS. If there are doubts about the completeness of data for an SSS, systems should consider completing an SMP instead of an SSS. Systems are encouraged to contact their State for an opinion if there are questions about the adequacy of an SSS. If a system decides not to conduct the SMP and completes an SSS that, after the State review process, is ultimately <u>not</u> approved by the State, that system would be in violation of the Stage 2 DBPR.

[1] EPA defines a *combined distribution system* as the totality of the distribution systems of wholesale systems and of the consecutive systems that receive finished water from those wholesale systems (40 CFR 141.2).

3.3 SSS Using Historical Data

This section describes an SSS that uses historical TTHM and HAA5 data to select Stage 2B monitoring sites. It provides guidelines for determining whether historical data are appropriate for use in an SSS (e.g., DBP sampling location and frequency, sampling periods, analytical quality, and correlation with existing system conditions). Sections 3.6 and 3.7 build on this section by showing how final Stage 2B compliance monitoring sites are selected based on SSS results and by listing minimum IDSE SSS reporting requirements.

3.3.1 Sample Site and Frequency

Historical data should be representative of your entire distribution system. At a minimum these data should meet the overall SMP requirements with respect to:

- Number of sites
- Location of sites
- Number of dual sample sets per site

Tables 1.4 and 1.5 summarize the SMP sample site requirements for various system sizes, source waters, and residual disinfectant types (Chapters 4 through 7 provide additional details). Historical sites that are generally equivalent to each of the required SMP sites should be specifically identified (e.g., near entry point, average residence time, representative high TTHM concentration). Using historical data from more sites than required for the SMP is acceptable and encouraged.

Consistent with SMP requirements, TTHM and HAA5 data should have been collected at each site. The interval for historical data collection (e.g., quarterly, biannually) should generally reflect SMP requirements for monitoring frequency. At a minimum, at least one set of historical TTHM and HAA5 samples should represent the month of peak distribution system temperature or peak historical TTHM levels. The collection period for historical data should be at least one full year, and sampling should have been conducted at evenly spaced intervals throughout the collection period.

Specific sampling requirements of the SMP do <u>not</u> have to be mirrored precisely in a historical data set, but the overall intent of the SMP should be satisfied. For example:

- If more sites per plant were sampled than are required by the SMP, fewer sample sets (e.g., quarterly instead of bimonthly) may be acceptable for the SSS, as long as the sample sets were collected at evenly spaced time intervals.

- If samples were collected quarterly (rather than bimonthly) for multiple years (rather than 1 year) at an appropriate number of sites, the data may be acceptable for an SSS, as long as the sample sets were collected at evenly spaced time intervals.

If historical data equivalent to the requirements of an SMP are not available, the completion of an alternative SSS using a combination of historical and newly collected TTHM and HAA5 data may be appropriate (see section 3.5).

3.3.2 Analytical Data Quality

Historical TTHM and HAA5 samples should have been analyzed using approved methods by a laboratory certified to perform these measurements under the Drinking Water Certification Program. Systems should contact their laboratory or State to confirm certification status. Appendix C describes the approved analytical methods for TTHM and HAA5. Note, HAA5 data collected before 2002 were likely not to have been analyzed by certified laboratories.

3.3.3 Historical Sampling Period

To ensure historical data represents current water treatment and distribution conditions, only data collected within the **10 years preceding the due date of the IDSE report** should be used for an SSS. Also, *at least* 50 percent of the historical samples should have been collected within 5 years prior to your system's IDSE report due date. Figures 3.1 and 3.2 depict recommended limits on historical sampling periods according the early and late schedules.

Figure 3.1 Recommended Limits of Historical Sampling Period for Systems on the Early Schedule

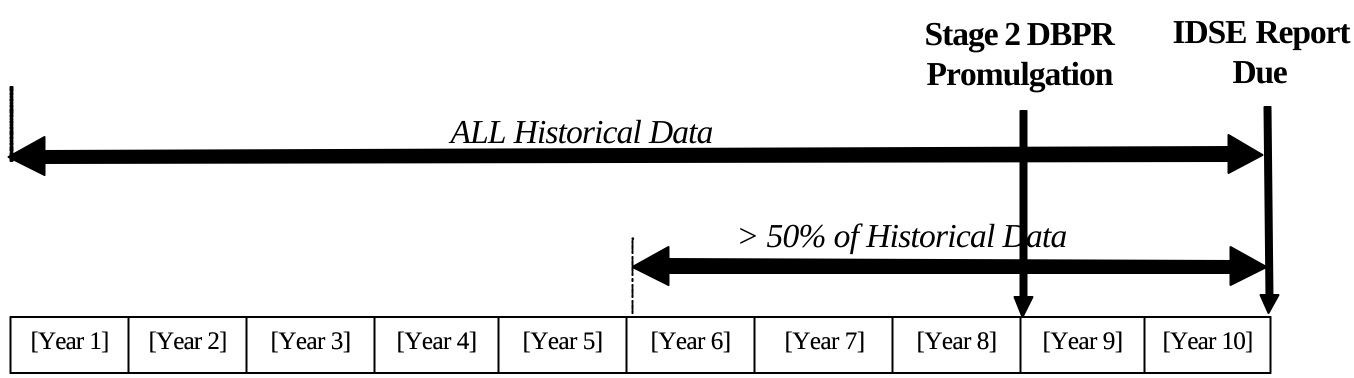
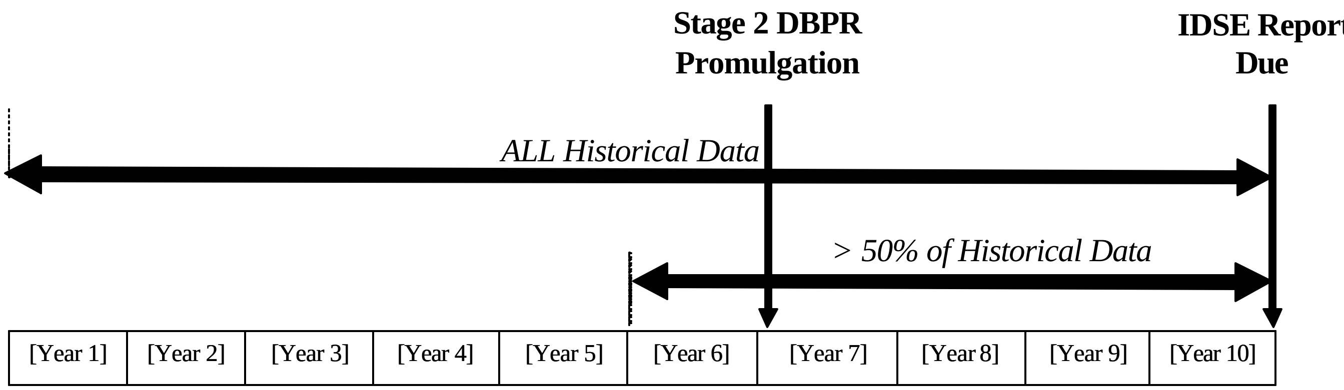


Figure 3.2 Recommended Limits of Historical Sampling Period for Systems on the Late Schedule



3.3.4 Treatment and Source Conditions

Historical data should reflect the source water(s) and treatment configuration in place at the time that your IDSE report is due (see Figures 3.1 and 3.2 for IDSE report schedules). Within the historical period, temporary changes, such as regular maintenance, rehabilitation, and upgrades of plant processes are generally acceptable. Temporary changes to disinfection practices (e.g., short duration switches to free chlorine for secondary disinfection to control nitrification in a chloraminated system and short duration emergency and special disinfection operations) are also generally acceptable within the historical sampling period. Data from short duration periods of unusual (not routine seasonal) system conditions could be excluded from the analysis of the historical data set, with appropriate justification to the State. Routine, repeating, and seasonal changes in supply or treatment should be allowable during the historical data period.

If a system made permanent changes that significantly affected DBP formation, plant production rates, and/or distribution systems, **only historical data representing conditions *after* the change should be used for an SSS.** Significant permanent treatment process or source changes that should be considered "cutoff points" for use of historical data include:

- Permanent changes in primary or secondary disinfection type or practice, such as:
  - Using a different disinfectant for primary disinfection
  - Switching to chloramines for secondary disinfection
  - Adding booster chlorination in the distribution system
- Major, permanent changes in raw water sources that significantly affected DBP concentrations in water produced by the plant (e.g., addition of a new water source)

- Major, permanent changes to plant configuration that affect disinfectant contact time (e.g., increasing clearwell volume with same flow rate of water through the clearwell)

- Major, permanent changes in treatment that affected DBP concentration in water produced by the plant (e.g., addition of granular activated carbon (GAC) or membranes)

Minor treatment changes that affected the magnitude of TTHM and HAA5 levels in the distribution system, but that are unlikely to have changed the DBP formation kinetics and relative levels of TTHMs and HAA5s in different parts of the system, are acceptable. For example, improved control of an existing coagulation process or minor changes in coagulation pH that reduce average levels of DBP precursors is acceptable, but switching from chlorine to ozone for primary disinfection is not. If treatment process or source changes have occurred and data collected prior to the change are utilized in an SSS, then the use of the data should be justified with an explanation of the change and a demonstration that it is unlikely to have significantly affected the relative TTHM and HAA5 levels in the distribution system.

3.3.5 Distribution System Conditions

The historical data set should also reflect the overall distribution system hydraulic operation and large scale movement of water through the system at the time an IDSE report is due (see Figures 3.1 and 3.2 for IDSE report schedules). Normal daily and seasonal changes in system operation during your historical sampling period should be acceptable. Supply points, pressure zones, large transmission mains, pump stations, storage tanks, and large wholesale and retail customers should generally be consistent throughout the historical sampling period, but do not have to remain exactly the same. A steady increase in water demand during the historical sampling period due to population growth should be acceptable if it did not result in major changes in water flow pattern and age within the distribution system.

Significant distribution system changes that should be considered as “cutoff points” for use of historical data include:

- Major, permanent changes in plant production rates, high service or booster pump station pumping rates, or pump operation schemes that significantly change the influence zones of treatment plants

- Major, permanent changes in water use patterns or system hydraulics, such as:

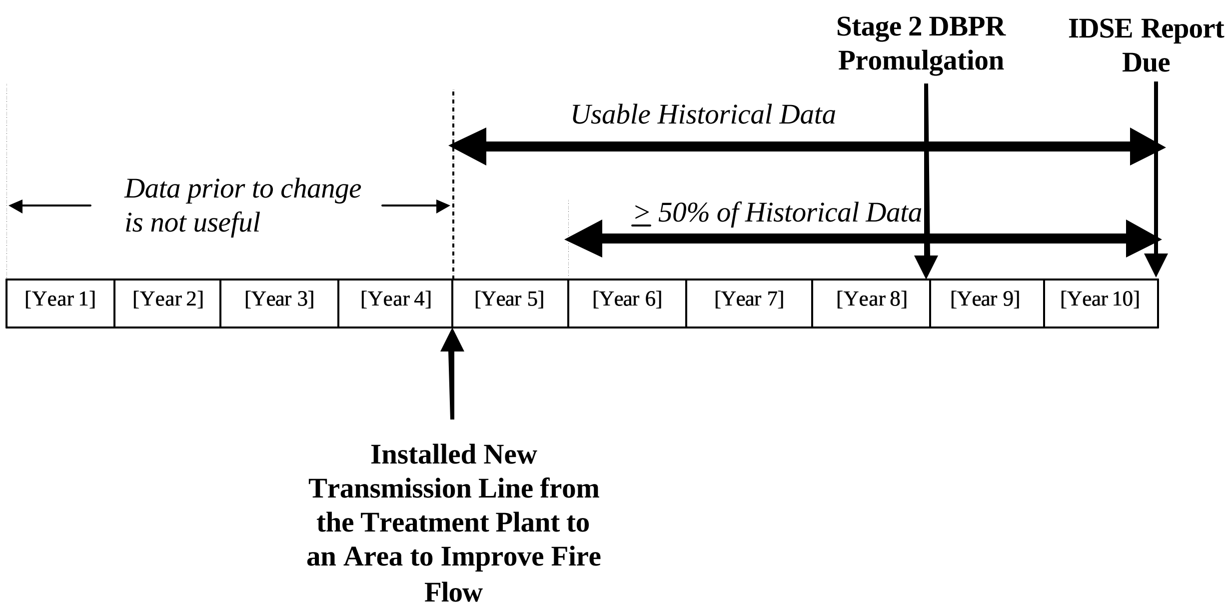
  - addition or removal of a very high water use industrial, institutional, or wholesale customer
  - addition, deletion, or replacement of mains, pump stations, or storage tanks that significantly change water flow patterns

– looping of mains

This list is not inclusive—systems should always use best professional judgement to determine if a distribution system modification affected the location of TTHM and HAA5 peaks.

Figure 3.3 provides an example of the acceptable historical sampling period for a surface water plant serving at least 10,000 people that placed a new large finished water transmission main into service within the last 10 years, changing distribution system hydraulics (e.g., flow rates, directions, and patterns).

Figure 3.3 Example of Historical Data Limitations for a System on the Early Schedule With a Significant Change in Distribution System Hydraulics



3.4 SSS Using a Water Distribution System Model

This section describes an SSS that uses a detailed, comprehensive, and well-calibrated water distribution system model to help select Stage 2B monitoring sites. There are two types of water distribution system models that can be used for the SSS—hydraulic models and water quality models. Because the complexity and accuracy of the models differ, section 3.4.1 recommends minimum requirements that should be met by the model.

Hydraulic models can predict water age, but they *do not* predict changes in water quality parameters, such as chlorine or TTHM concentrations. Water quality models can reasonably predict disinfectant residuals and, in some cases TTHM concentrations, in addition to hydraulic patterns in distribution systems. A well-calibrated water quality model may provide more data that could lead to superior selections of Stage 2B compliance sites compared to hydraulic models. However, proper calibration of the water quality component can be a difficult task and is typically done with much less accuracy than calibration of the hydraulic component. Thus, the minimum requirements for the predefined SSS are focused only on the hydraulic component of water distribution system models. If a system decides to use a water quality model, they are encouraged to provide information on the water quality calibration to the State.

Operation of a water distribution system should be simulated over extended periods to reflect maximum residence time in the system under conditions of high TTHM and HAA5 formation potential. The period of high TTHM and HAA5 formation potential for many systems will occur during the summer months (although this is not the case for all systems). The operation and behavior of treated water storage facilities must also be well-characterized in the model. The results should then be used to determine:

- The spatial and temporal patterns of water movement from all plants (if there are multiple sources of supply)

- The <u>typical</u> pattern of residence time in the system during the period of high TTHM and HAA5 formation potential

Model results should be combined with at least one round of TTHM and HAA5 sampling at sites that, at a minimum, meet SMP requirements for number and type of site. These results will be used in selecting final Stage 2B compliance monitoring sites.

This section provides detailed guidance for the following topics:

- Minimum model requirements (including modeled components, simulation of water consumption, and model calibration)

- Selecting preliminary sites that meet SMP requirements based on model outputs

- Performing at least one round of TTHM and HAA5 monitoring during the month of peak TTHM concentrations or peak temperature (additional sampling beyond one round or at additional sites is allowed and encouraged)

Section 3.7 shows how modeled results, one round of monitoring data, and TTHM and HAA5 compliance monitoring results are used to select final Stage 2B compliance monitoring sites.

The option of using a water distribution system model is intended to allow systems that have models to use their *existing* technical resources to perform the IDSE. For many systems, developing a detailed and well-calibrated water distribution system model from scratch and training staff to use it will cost more than conducting an SMP. If the model will be used for other purposes after the completion of the SSS, such as optimizing system operations and prioritizing capital improvements, then the cost of the model development may be justified.

If your model *does not* meet the criteria described in this section, you may be able to upgrade the model or use it in combination with other data and/or analyses for your SSS. These alternative SSSs might involve the use of less robust models, supplemented with data from tracer studies or more extensive historical or new TTHM and HAA5 monitoring data (see Section 3.5 for alternative SSSs).

3.4.1 Minimum Model Requirements

In general, your water distribution system model should be more comprehensive for the purpose of an SSS than models typically used for long-range capital improvement program analysis (e.g., master planning). A calibrated hydraulic model intended for detailed distribution system design (e.g., for system improvements) or operational studies is likely to be adequate. A well-calibrated water quality model is likely to be acceptable.

Because systems are always changing (e.g., population growth, new industries, aging of mains), it is important that your model generally reflect system conditions and demand at the time of the IDSE SSS. A model that has not been updated or calibrated in the last 10 years is unlikely to be adequate for the SSS.

Note that the guidelines in this section are not comprehensive—every distribution system is unique. Systems and States should always use their best professional judgement when determining model adequacy for the SSS.

3.4.1.1 Model Details

Most water distribution system models do not include every pipe in a distribution system. Typically, small pipes near the periphery of the system and other pipes that affect relatively few customers are excluded to a greater or lesser extent depending on the intended use of the model. This process is called *skeletonization*.

It is a generally accepted practice to skeletonize models to a certain extent depending on the model's intended use. To be used for the purposes of this predefined SSS, the model should be relatively detailed and include the majority of pipes in the distribution system. EPA recommends that a model used for an SSS generally include the following:

- At least 50 percent of total pipe length in the distribution system
- At least 75 percent of the pipe volume in the distribution system
- All 12-inch diameter and larger pipes
- All 8-inch and larger pipes that connect pressure zones, influence zones from different sources, storage facilities, major demand areas, pumps, and control valves, or are known or expected to be significant conveyors of water
- All 6-inch and larger pipes that connect remote areas of a distribution system to the main portion of the system
- All storage facilities, with controls or settings applied to govern the open/closed status of the facility that reflect standard operations
- All active pump stations, with realistic controls or settings applied to govern their on/off status that reflect standard operations
- All active control valves or other system features that could significantly affect the flow of water through the distribution system (e.g., interconnections with other systems, valving between pressure zones)

If a model used to conduct an SSS does not generally meet these criteria, additional justification of the suitability of the model for use in an SSS should be provided to the State in the IDSE report.

3.4.1.2 Accurate Simulation of Water Consumption

Water consumption (demand) should be accurately simulated in the model:

- Water demand should be allocated among the nodes of the model in a manner that reflects the actual spatial distribution of such demand throughout the system and with fineness of detail appropriate for the system size, in order to assure the model will provide a realistic simulation of water flow throughout the system.

- As the level of detail (percentage of pipe modeled compared to actual total length of pipe in the system) of a model increases, the percentage of nodes with demand assignments can sometimes be less than that would be needed in a less detailed model, without significantly impacting the overall accuracy of the model.

- Water demand should generally be assigned to all end nodes so that the flow of water is simulated in dead-end pipes and remote areas of a system.

- Demand data should reflect, at a minimum,

  - domestic water use
  - large commercial and industrial users
  - unaccounted for system water losses
  - seasonal trends

- A system-specific, diurnal (24-hour) demand pattern should be applied to the overall system demand. Demand patterns can be derived from a review of master meter flows, tank levels, pumping rates, or other similar operational data.

- The model should accurately simulate seasonal system configuration and operational changes to meet changes in demand, such as a reservoir that is taken out of service during winter months, or a large seasonal user (e.g., a campground).

3.4.1.3 Model Calibration

Generally, calibration is the process of:

- Compiling field data on pressures, flows, and tank water levels in the system under known conditions

- Comparing model results with field data

- Adjusting the model (e.g., pipe roughness factors, tank/pump operational settings, etc.) to agree with field data

Calibration is never exact, and there are no official calibration standards or guidelines in the United States. There is general agreement in the modeling profession that the extent of calibration should reflect the intended uses of the model. For example, a more rigorous model calibration is expected when the model is used for design work compared to master planning. For the purposes of the SSS, a slightly less rigorous calibration compared to design work is most likely to be adequate. Calibration performed several years ago for the purposes of general master planning **may not be acceptable**. For more information regarding the calibration of distribution system hydraulic models, refer to *Modeling Water Quality in Drinking Water Distribution Systems* (Clark and Grayman 1998, AWWA) or *Advanced Water Distribution Modeling and Management* (Beckwith et al. 2002, Haested Methods), or other reference books.

It is recommended that systems verify the reasonableness of their model calibration by comparing residence time estimates with disinfectant residual data. To do this, plot (electronically or by hand) the residence time estimates obtained from your model and disinfectant residual monitoring results on a map of the distribution system. A system should generally find that average disinfectant residuals are similar for locations with equivalent residence times (disregarding pipe tuberculation, biofilm, etc.). If actual disinfectant residuals are *not* similar in areas with similar modeled residence times, it is possible your calibration is insufficient or differences in tuberculation and biofilm between the areas being compared have affected the disinfectant residuals. If systems encounter this situation, but believe their model calibration is accurate, they should provide a justification for the data inconsistency in the IDSE report.

3.4.2 Identifying Preliminary Sites Using Model Results

To select preliminary monitoring sites using a water distribution system model, systems should:

- Run the model in extended period simulation (EPS) mode until a consistent, repeating temporal pattern of water age is established at all nodes of the model. Generally, the model should be run under high DBP formation conditions (typically summer months).

- Choose preliminary sites satisfying the SMP sample site requirements based on water age results. (See section 1.3.5 for a summary of SMP requirements.)

The rule requires an SSS include an analysis demonstrating that the SSS characterized expected TTHM and HAA5 levels throughout the distribution system (40 CFR 141.604(a)). This approach recommends systems, at a minimum, conduct one round of sampling (collecting dual sample sets) at the preliminary sites during the month of peak TTHM levels or water temperature in the distribution system (one round of monitoring is addressed in section 3.4.3).

Model results and all available TTHM and HAA5 data monitoring results are combined to select Stage 2B compliance monitoring sites (see section 3.6). The use of a water quality model would be similar, but instead of choosing preliminary sites based on water age results, chlorine residual or TTHM results would be used. The following sections describe a pre-defined SSS option that involves the use of a water distribution system model for identifying preliminary monitoring sites.

3.4.2.1 EPS Modeling to Estimate Residence Time, Influence Zones, and Mixing Zones

When a water distribution system model is used to estimate residence times, influence zones, and mixing zones, the modeling must be performed in EPS mode instead of the steady-State simulation mode. In EPS modeling, variables such as water demands and tank water levels are allowed to change over time (in steady-State modeling, all variables remain constant over time). EPS models should be run until a consistent or consistently repeating pattern of residence time is established at all nodes of the model. Typically, a repeating 24-hour pattern of water use (demand) and system operations are assumed in EPS modeling. Depending on particular system characteristics and the specific starting conditions imposed on the model, an EPS model may require a simulation time of 7 to 21 days or more for a consistent pattern of residence time to develop. An EPS model usually needs to be run much longer than the actual maximum residence time of water in a particular distribution system before a consistent pattern of residence time is attained at the system extremities.

The model should be run under conditions of high DBP formation potential. In most areas of the United States, water demand and system operation vary seasonally. Seasonal variations can generally be classified into summer conditions (high usage), winter conditions (low usage), spring-autumn conditions (medium usage), or wet and dry period conditions. In applying a model to select preliminary Stage 2B monitoring sites, the examination of summer usage will generally suffice if summer conditions represent the period of peak TTHM formation potential. The consideration of additional usage conditions is acceptable.

In systems with multiple plants, source tracing should be used to determine zones of influence and mixing zones. Most models have a "source tracing" option in which the percentage of water coming from a single source can be traced over the course of several days. By tracing each source separately, a map can be generated showing areas that predominantly receive water from a single source and areas with mixing zones where, either on a diurnal or a seasonal basis, water is received from multiple sources. This information is used to make informed selections of sampling sites that are representative of a single source or a mixing zone.

3.4.2.2 Preliminary Sample Site Selection to Meet SMP Criteria

The residence time, influence zone, and mixing zone information developed through modeling should be used to select preliminary sites. The number of preliminary sites should equal or exceed the required number of SMP sites. Stage 1 monitoring sites should <u>not</u> be selected as preliminary sites for one round of monitoring. The type of preliminary sites (near entry point, high TTHM, high HAA5, and average residence time) should also generally mirror SMP sites for your system size and source water type. See section 1.3.5 for a summary of SMP site criteria according to system size and source water type; see Chapters 4 through 7 for more details.

The next three sections provide detailed guidance on selecting high TTHM, high HAA5, and average residence time sites. Appendix B provides additional information regarding TTHM and HAA5 formation that could be useful in selecting these sets. Because hydraulic models usually are somewhat skeletonized and have varying degrees of calibration and accuracy of demand allocation, best professional judgement should always be used when analyzing the results and using model outputs to assist in the selection of preliminary sites.

High TTHM Sites

High residence time locations (most often high TTHM sites) can be identified by reviewing the modeled water age at each node in the model. When the run time of an EPS model is long enough to produce a consistent pattern of water age values at all nodes, sometimes with repeating fluctuations due to diurnal variations in water demands, then the water age values at the model nodes can be used for the purposes of identifying high residence time locations.

One way to show high residence time sites is by color coding each model node according to its residence time. High TTHM sites should be chosen from the area or areas of the distribution system where the high residence time model nodes are located. The sites do not have to be chosen at the *exact* location of a model node, just in the general area identified by the model results.

Precautions in using model data to select high TTHM sites include:

- If no water demand is applied to dead-end nodes in a model or if the water demand in a dead-end is highly uncertain, the water age results for those nodes can be unrealistic and meaningless.

- The accuracy of water age estimates from a model generally decreases as the model moves from large diameter mains to small diameter mains to subdivision piping and dead-ends. This is due to the increasing uncertainty in water usage rates as the system moves away from large, aggregate demands to smaller demands exerted by a few customers or a single customer.

- If the model is skeletonized, the model results for high residence time areas should be compared to maps of the actual distribution system piping and to actual customer locations in those areas before sample sites are finalized in order to assure that the sample site is representative of the actual distribution system and not just the skeletonized model in the high residence time areas.

- Residence time is just one factor for identifying high TTHM sites and should be compared with other distribution system data (e.g., disinfectant residual data) before making preliminary site selections.

In some cases, there can be zones in the distribution system where water flowing from opposite directions meet. This can occur in:

- Long, looping mains

- The interface of the influence zones of two or more different supply points

- Areas where different pressure zones meet within one system

This type of area is sometimes called a "mixing zone" and may act as a hydraulic dead-end. Mixing zones can occur anywhere in the distribution system, but occur more often in the central portion of a distribution system. If the water demand in the mixing zone is low, then the water age and TTHM concentrations could be high. Water distribution system models can be useful in locating mixing zones and identifying high TTHM sites within the mixing zone.

High HAA5 Sites

The criteria and procedure for selecting high HAA5 sites using a hydraulic model is generally the same as that described above for selecting high TTHM sites with one important difference: the sites chosen to represent high HAA5 should have a detectable disinfectant residual. HAA5 concentrations typically increase in distribution systems as water age increases but can also decrease if disinfectant residuals are not present and biological activity is high. It is generally recommended that high HAA5 sites be selected in areas with a minimum chlorine residual of 0.2 mg/L or a minimum chlorine residual or 0.5 mg/L.

Average Residence Time Sites

Average residence time sites can be selected from sites with residence times close to the *flow-weighted* mean of all nodal residence times (or system average). As with selecting high TTHM/HAA5 sites, color coding nodes by nodal residence time can be helpful. Preliminary sample sites should be chosen from the area or areas of the distribution system where the nodal residence time is close to the system average. The preliminary sites do not have to be chosen at the *exact* location of a model node, just in the general area identified by the model results. Selected sites should represent the entire distribution system and should not be clustered.

3.4.3 Performing At Least One Round of Sampling

Although hydraulic models can be used to reasonably predict residence times, the behavior of HAA5 cannot be directly predicted based on residence time in a distribution system. Therefore, to meet the rule requirement of demonstrating model accurately characterized expected TTHM and HAA5 levels (40 CFR 141.604(a)), this approach recommends systems perform at least one round of sampling at preliminary sites (i.e., collecting dual sample sets at each site). Generally, the TTHM concentrations from this sampling should confirm the model predictions of residence time and verify the selection of preliminary sites.

If only one round of sampling is performed, it should occur in the month of peak TTHM levels or water temperature in the distribution system. Additional rounds of sampling are allowed and encouraged. All results should be considered in the selection of Stage 2B compliance monitoring sites and included in the IDSE report. Stage 1 DBPR compliance monitoring and other historical TTHM and HAA5 data should be considered, if available, and included in the IDSE report.

If the results from Stage 1 DBPR compliance monitoring and the single round of sampling are <u>not</u> reasonably consistent with modeled residence times, the potential reason for the discrepancy should be explained in the IDSE report. If factors such as demand variations, distribution system operations, tank operations, tank cleaning, or new construction are thought to have impacted the sampling results, then the specifics of these factors should be included in the IDSE report. One or more additional rounds of sampling may also be performed and are encouraged. Modeling revisions might be needed if actual conditions during the sampling were found to be different than modeled conditions. In this case, select new preliminary sites and repeat the monitoring.

It is recognized that distribution system modeling results usually do not completely reflect the true range and variability of hydraulic and water quality conditions that exist in distribution systems. This limitation of modeling allows for some amount of variability between sampling and modeling results. However, if significant inconsistencies exist between modeling results and the required one round of sampling, then additional explanation would need to be provided in the IDSE report.

3.5 Alternative SSSs

EPA recognizes that there are many combinations of data and analyses that can be used for an SSS. Potential combinations include, but are not limited to:

- Historical data supplemented with new data

- Historical data and tracer study results
- New TTHM and HAA5 data, distribution system modeling, and tracer study results

In general, any alternative SSS should be representative of the majority of the distribution system, including the extremities, and provide equivalent or superior data for the selection of Stage 2B monitoring sites compared to an IDSE SMP.

Section 3.5.1 lists questions that States should consider when evaluating an alternative SSS. Sections 3.5.2 and 3.5.3 provide guidelines for two alternative SSSs: historical DBP data supplemented with new DBP data, and historical or new DBP data combined with a tracer study. The guidelines listed in this section are NOT definitive—SSSs will always be evaluated on a case-by-case basis by the State.

3.5.1 Evaluation of Alternative SSSs

The following is a list of questions that States should consider when evaluating an SSS:

1) Does the study adequately evaluate the extremities? Does the study target other potential areas with long water residence times?
2) Do the historical data meet the specified criteria for analytical quality and represent existing distribution system conditions (see section 3.3)?
3) Does the study cover at least 1 continuous year?
4) Are there data representing the month of peak TTHM or highest temperature?

3.5.2 Historical Data Combined with New Data

The total number of samples analyzed should be equal to or greater than the total number of samples required for the IDSE SMP (see Tables 1.4 and 1.5). The type of monitoring site should also satisfy the SMP requirements.

Example 3.1 Monitoring Requirements for a Surface Water System Serving More Than 10,000 People

If your system is a producing surface water system serving more than 10,000 people using free chlorine for residual disinfection, your combined historical and new TTHM and HAA5 data should represent, at minimum:

1) At least eight sample sites per treatment plant, with at least one representing a near entry point, two representing average residence time areas, three representing high TTHM areas, and two representing high HAA5 areas.

1) At least six TTHM and HAA5 sample results from each site (equivalent to requirements for SMP monitoring), with at least one group of samples collected during the month of historical peak TTHM levels or high water temperature.

Historical data should meet the requirements and general guidelines in section 3.3. New sampling should be performed to fill in "gaps" in historical data as needed to meet the minimum number of samples and coverage of the distribution system. Treatment, source water, and distribution system conditions should be similar during the historical and new sampling periods, in accordance with the requirements and guidelines in sections 3.3.4 and 3.3.5. In cases where all historical data are used for some locations and all new data for other locations, there should be no permanent changes to treatment, source water, and distribution system conditions that affect the overall magnitude of TTHM and HAA5 concentrations between the historical and new data sampling periods. The selected sites should adequately represent the entire distribution system.

3.5.3 Historical or New DBP Data Combined with a Distribution System Tracer Study

Time-of-travel tracer studies can be used to determine actual water residence times in a distribution system under specific conditions, and are sometimes used to calibrate water distribution system models. They are particularly useful for predicting water residence time in areas of a system where there is uncertainty about true pipe diameters due to poor records or the buildup of corrosion deposits. When pipe diameters in a model are inaccurate, model predictions can be very different than the actual hydraulic conditions in a distribution system.

Although tracer studies often provide very good information, they can be time consuming and costly. Conducting a tracer study solely for the IDSE SSS may not be cost effective. However, if your system is considering a tracer study for some other purpose (e.g., calibrating a hydraulic model), consideration should be given to using the tracer study as a tool for the IDSE SSS. Also, results from *previously conducted* tracer studies may be very useful in identifying areas in the distribution system with high and average residence times.

Tracer studies can be performed by monitoring the concentration of a conservative constituent (i.e., a chemical that does not degrade over time) through the distribution system. Chemicals used for tracers must not be harmful to people or the environment. Tracer chemicals can be substances that are:

- Specially injected or normally injected in the water for treatment purposes (e.g., hydrofluorosilic acid or sodium fluoride)

- Characteristic of the finished water (e.g., hardness, conductivity)

Before injecting any tracer, a baseline concentration of the tracer in the distribution system water should be determined (fluoride, the most common tracer, may be normally present in trace amounts). If your system adds fluoride, you can turn off the fluoride feed for a period of time, and monitor the resulting decrease of its concentration throughout the distribution system.

If you do not routinely add fluoride to the finished water, you can conduct tracer tests by injecting a small dose of fluoride (about 1 mg/L) into the water entering the distribution system. However, flouride can interact with the material deposited inside pipes and storage facilities which reduces the accuracy of the calculated residence times. As a result, you must inject sufficient fluoride to meet the "fluoride demand" of your distribution system while assuring that fluoride concentrations in the distribution system do not exceed allowable concentrations of 4 mg/L (the primary MCL for fluoride is 4 mg/L and the secondary MCL which is non-enforceable is 2 mg/L). If other tracers are used such as calcium chloride or sodium chloride, State environmental agencies may require that food grade chemicals are used or that other assurances are made concerning the safety of the tracer. With some tracer chemicals, systems may want to consider notifying sensitive users.

When selecting tracer monitoring locations, you should consider the following:

- Major intersections or branches in large transmission mains

- Branches in minor mains where flow is split between two or more groups of customers

- Storage tanks

- Entry points to large commercial or industrial users

- Sites prior to the last fire hydrant in remote areas with few customers

To adequately characterize distribution system residence time, tracer concentrations must be measured frequently and in relatively close proximity to one another. The frequency of sampling will determine the accuracy of the study results. For example, if sampling is conducted every 8 hours, the water age at a given site will only be accurate to within 8 hours. Furthermore, the proximity of sample sites to one another will also affect the accuracy of the study results. It may be appropriate to space samples far apart on large transmission mains, but within the distribution system (which contains many piping and hydraulic interactions), samples should be located more closely together.

The following are general guidelines for using a tracer study as part of a SSS:

- In general, the tracer study should reflect the existing distribution system configuration and should have been conducted within the last 10 years. If permanent and significant changes to demand, piping, pumping, or storage have occurred since the tracer study was completed, the study may not be suitable for an SSS.

- The tracer study should generally represent conditions of high DBP formation potential and high water age (typically summer months and low demand periods for most systems).

- The tracer study should be detailed enough to provide good characterization of water residence time for the entire distribution system. Not all extremities must be covered by the study, but the data should be complete enough to allow for a reasonable extrapolation of the results to cover the entire distribution system.

- If the tracer study does not provide residence time information for the extremities of the distribution system, then historical TTHM and HAA5 data should be reviewed if available, or new data should be collected at expected representative high TTHM and HAA5 sites.

- Regardless of the level of detail of the tracer study, systems should have historical data for at least one complete round of sampling at the preliminary sites or should perform at least one new round of sampling at the preliminary sites (see section 3.4.3 for guidance on conducting one round of sampling). At a minimum, one round of sampling should occur during the month of historical peak TTHM levels or highest water temperature, if the historical peak TTHM month is unknown.

3.6 Selecting Stage 2B Compliance Monitoring Sites Using SSS Results

This section describes procedures for using results of an SSS to select Stage 2B compliance monitoring sites. Tables 3.1 and 3.2 summarize the Stage 2B monitoring requirements for producing and 100 percent purchasing systems, respectively (Chapter 1 also provides this information).

Section 3.6.1 addresses selection of high TTHM and high HAA5 sites, while Section 3.6.2 addresses selection of average residence time Stage 2B sites using SSS results (note that only a subset of systems need to select average residence time sites, as addressed in Section 3.6.2). Section 3.6.3 provides examples of site selection. Appendix K contains an example IDSE report where a hydraulic model was used to select Stage 2B compliance sites, and Appendix J contains an example IDSE report where historical data were used to select Stage 2B compliance sites.

Table 3.1 Stage 2B Plant-based Compliance Monitoring Requirements for Producing Systems[1,2]

System Size (Population Served[3])	Number of Distribution System Sites (by type of site) per Plant[4]			Total Number of Sites per Plant	Monitoring Frequency[5]
	Stage 1 Average Residence Time	Highest TTHM	Highest HAA5		
Surface Water Systems[6]					
< 500	-	1	1	**2[7]**	Every 365 days
500 - 9,999	-	1	1	**2**	Every 90 days
≥ 10,000	1	2	1	**4**	Every 90 days
Ground Water Systems					
< 500	-	1	1	**2[7]**	Every 365 days
500 - 9,999	-	1	1	**2**	Every 365 days
≥ 10,000	-	1	1	**2**	Every 90 days

1 (40 CFR 141.605 (a))

2 For the purpose of this guidance manual, *producing systems* are those that do not buy 100 percent of their water year-round (i.e., they produce some or all of their own finished water).

3 *Population served* is typically a system's retail population. It should not include populations served by consecutive systems that purchase water from that system.

4 For the purposes of the Stage 2 DBPR compliance monitoring, a consecutive system entry point that operates for at least 60 consecutive days per year must be considered a plant (40 CFR 141.601(d)).

5 Monitoring frequency is the approximate number of days between monitoring events. A dual sample set must be collected at each site, unless otherwise noted. A dual sample set is one TTHM and one HAA5 sample that is taken at the same time and site.

6 For the purpose of this guidance manual, "surface water systems" are equivalent to subpart H systems (i.e., any system that uses surface water or GWUDI as a source, including all mixed systems that use some surface water or GWUDI and some ground water).

7 Dual sample sets are not required at both the high TTHM and the high HAA5 site—if the highest TTHM and HAA5 levels occur at a different site, then only one sample is collected at each site. If they occur at the same site, then a dual sample set is collected at that site.

Table 3.2 Stage 2B Population-based Compliance Monitoring Requirements for 100 Percent Purchasing Systems[1,2]

System Size (Population Served[3])	Number of Distribution System Sites (by type of site) per System			Total Number of Sites per System	Monitoring Frequency[4]
	Stage 1 Average Residence Time	Highest TTHM	Highest HAA5		
Surface Water Systems[5]					
< 500	-	1	1	**2**[6]	Every 365 days
500 - 4,999	-	1	1	**2**[6]	Every 90 days
5,000 - 9,999	-	1	1	**2**	Every 90 days
10,000 - 24,999	1	2	1	**4**	Every 90 days
25,000 - 49,999	1	3	2	**6**	Every 90 days
50,000 - 99,999	2	4	2	**8**	Every 90 days
100,000 - 499,999	3	6	3	**12**	Every 90 days
500,000 - 1,499,999	4	8	4	**16**	Every 90 days
1.5 million - < 5 million	5	10	5	**20**	Every 90 days
≥ 5 million	6	12	6	**24**	Every 90 days
Ground Water Systems					
< 500	-	1	1	**2**[6]	Every 365 days
500 - 9,999	-	1	1	**2**	Every 365 days
10,000 - 99,999	1	2	1	**4**	Every 90 days
100,000 - 499,999	1	3	2	**6**	Every 90 days
≥ 500,000	2	4	2	**8**	Every 90 days

1 (40 CFR 141.605 (e))

2 For the purpose of this guidance manual, *100 percent purchasing systems* are those systems that buy or otherwise receive all of their finished water from one or more wholesale systems year-round.

3 *Population served* is typically a system's retail population. It should not include populations served by consecutive systems that purchase water from that system.

4 Monitoring frequency is the approximate number of days between monitoring events. A dual sample set must be collected at each site, unless otherwise noted. A dual sample set is one TTHM and one HAA5 sample that is taken at the same time and site.

5 For the purpose of this guidance manual, "surface water systems" are equivalent to subpart H systems (i.e., any system that uses surface water or GWUDI as a source, including all mixed systems that use some surface water or GWUDI and some ground water).

6 Dual sample sets are not required at both the high TTHM and the high HAA5 site—if the highest TTHM and HAA5 levels occur at a different site, then only one sample is collected at each site. If they occur at the same site, then a dual sample set is collected at that site.

3.6.1 Selecting High TTHM and HAA5 Sites

Selection Using a Historical Data SSS

The following steps detail how Stage 2B sites should generally be selected based on historical TTHM and HAA5 data. These steps also apply to systems using a combination of historical and new data.

1) Calculate the Locational Running Annual Average (LRAA) for TTHM and HAA5 concentrations at each historical data site. Historical data should cover at least 1 full year. If your data covers a longer period, calculate separate annual averages for each full year. Select the data for the year with highest average for each site (see the example in Appendix L for sample calculations).

2) Calculate the LRAA for TTHM and HAA5 concentrations at the Stage 1 DBPR maximum residence time site(s). If your data covers more than 1 year, calculate separate averages for each full year. Select the data for the year with highest average for each site.

3) Select high TTHM and high HAA5 sites starting with the highest TTHM and HAA5 LRAAs from both the Stage 1 DBPR compliance monitoring sites and historical data sites.

TTHM and HAA5 LRAAs are the most important factors to consider when selecting Stage 2B monitoring sites. However, the Stage 2 DBPR allows for some flexibility in selecting Stage 2B compliance sites. Other factors should be considered and may lead to selecting a site with a slightly lower LRAA over another site. The following conditions are possible reasons why you may select a site with a lower LRAA over another site:

- The site provides for more complete geographic coverage of the entire distribution system

- The site allows you to maintain an historical record

- Sampling at that site provides the opportunity to collect other water quality or operational data (e.g., chloramine systems may want to collect nitrate data at that site)

If you do not use your highest TTHM and HAA5 LRAAs to select your Stage 2B sites, you must provide justification for your selection in your IDSE report (40 CFR 141.605).[2]

Selection Using a Water Distribution System Model SSS

The first step in selecting Stage 2B sites is to compare the model-predicted residence times for your preliminary sites with the TTHM and HAA5 concentrations from the one round of sampling, Stage 1 compliance monitoring results, and any other historical TTHM and HAA5 data. Are the results consistent? In other words, do those sites with the highest residence time also represent those sites with the highest TTHM concentrations?

Ideally, the preliminary or Stage 1 DBPR sites with the highest TTHM and HAA5 sampling results should be selected as the Stage 2B high TTHM and high HAA5 sites. However, TTHM and HAA5 data collected during the one round of sampling at preliminary sites may not represent typical levels. Distribution conditions at the time of sampling should be taken into account. EPA recognizes that one round of samples reflects only a snapshot of the distribution system. Modeled data represent a more comprehensive picture of the distribution system, and therefore, may not agree with the sampling results. If your modeled data and sampling results do not agree and you select a site based on modeled results, you should explain your rationale for selecting that site in your IDSE report.

For example, say that a model predicts that "Site A" normally receives water from the West Tank during the daytime hours. The TTHM and HAA5 results from Site A were much lower than expected, compared to other sites. Upon reviewing the tank operating data from the day of sampling, it is likely that the site was <u>not</u> receiving water from the West Tank during the time of sampling due to low system demand that day. In this situation, the system may want to select Site A as a Stage 2B compliance monitoring site based on the modeled data and noting in the IDSE report the discrepancy between modeled data and sample results.

You should also consider other factors such as geographic coverage when selecting sites. It is acceptable to pick a site with a slightly lower TTHM or HAA5 result over another if the selected site provides better geographic coverage; however, you must provide your rationale for selection in the IDSE report.

---

[2] The Stage 2 DBPR does not specify a difference between two LRAAs that allows selection of a site with the lower LRAA for Stage 2B. EPA recognizes there is uncertainty and variability associated with the TTHM and HAA5 data quality. While the LRAA calculation reduces the impact of these to some extent, they can cause a small difference between two LRAAs to be statistically insignificant and thus, making the selection of the Stage 2B site dependent on other factors. The intent of the Stage 2 DBPR is to reduce peak DBP concentrations in the distribution system. You should use best professional judgment to select Stage 2B sites with consideration to the intent of the rule and demonstrate to the State the reason for the selection.

.

3.6.2 Selecting Average Residence Time Sites

The following systems are required to select average residence time site(s) for the Stage 2B (40 CFR 141.605):

- 100 percent purchasing surface water or ground water systems serving at least 10,000 people

- Producing surface water systems serving at least 10,000 people.

One of the purposes of the Stage 2B average residence time site is to ensure that a historical data record of system DBP levels is maintained (i.e., systems keep one site the same from Stage 1 to Stage 2 DBPR). Producing systems can meet this goal by selecting their Stage 2B average residence time site from their three Stage 1 DBPR average residence time sites (guidelines for selecting from Stage 1 DBPR compliance monitoring sites are provided below). 100 percent purchasing systems may not have average residence time sites under the Stage 1 DBPR requirements.[3] In these situations, they must alternate between high HAA5 and high TTHM sites to fill the required number of Stage 1 average residence time sites.

Producing Systems

Systems must select their Stage 2B average residence time site (one per plant) from the three existing Stage 1 DBPR average residence time sites. Stage 2B average residence time sites should have the highest TTHM or highest HAA5 LRAA among the Stage 1 DBPR average residence time sites, considering the most recent year of data. If the high TTHM and high HAA5 LRAAs do not occur at the same site, consider other factors such as geographical coverage and how close LRAAs are to the MCLs, in order to decide between the two sites. Considering the second situation, if the high TTHM LRAA is 70 µg/L and high HAA5 LRAA is 35 µg/L, then the site with the high TTHM LRAA is the better choice.

[3] 100 percent purchasing ground water systems serving at least 10,000 people were not required to have average residence time sites for Stage 1 DBPR. 100 percent purchasing surface water systems may have an average residence time Stage 1 DBPR site, depending on the monitoring plan for their combined distribution system.

3.6.3 Examples of Stage 2B Site Selection

This section provides examples of Stage 2B site selection:

Example 3.2 Selecting Stage 2B Sites from Historical Data

Example 3.3 Maintaining an Historical Record

Example 3.4 Providing Geographical Coverage When Choosing Stage 2B Sites

Example 3.2 Selecting Stage 2B Sites from Historical Data

A producing water system serves 90,000 people and has one surface water treatment plant. This system must select **4** Stage 2B compliance sites: 2 high-TTHM sites; 1 high-HAA5 site; and 1 from the 3 existing Stage 1 DBPR average residence time compliance sites. The table below lists the TTHM and HAA5 LRAAs for all Stage 1 DBPR compliance monitoring sites and three of the eight historical sites (these data represent the seven highest TTHM and HAA5 LRAAs).

Site	TTHM LRAAs	HAA5 LRAAs
A (Stage 1 max. residence time)	70 (1st year) , 69 (2nd year)	51 (1st year), 49 (2nd year)
B (historical high TTHM site)	66 (1st year), 64(2nd year)	40 (1st year), 38 (2nd year)
C (historical high HAA5 site)	72 (1st year), 71 (2nd year)	53 (1st year), 50 (2nd year)
D (historical high TTHM site)	76 (1st year), 72 (2nd year)	50 (1st year), 49 (2nd year)
E (Stage 1 avg. residence time)	57	48
F (Stage 1 avg. residence time)	42	30
G (Stage 1 avg. residence time)	55	50

Selecting the Average Residence Time Site

The average residence time site should have either the highest TTHM or highest HAA5 LRAA of the Stage 1 DBPR average residence time sites. The water system may choose either Site E (highest TTHM LRAA) or Site G (highest HAA5 LRAA). With two valid options, the site providing the best geographic coverage is preferred. Site G is located downstream of an elevated tank and is the only site that receives water from that tank; therefore, the water system selects **Site G**.

Example 3.2 Selecting Stage 2B Sites from Historical Data (cont.)

Selecting the High-TTHM Sites

Site D has the highest TTHM LRAA. Therefore, this site is chosen as the first of the high-TTHM sites. **Site C** has the next highest TTHM LRAA, and **Site A** has a slightly lower TTHM LRAA than Site C. The difference in the TTHM values between Site A and Site C is minimal, and Site A is a Stage 1 DBPR "maximum compliance" site. Because the difference between the TTHM LRAAs of Site A and C are minimal, and Site A would maintain a historic record of sampling, **Site A** is chosen as the second high-TTHM site.

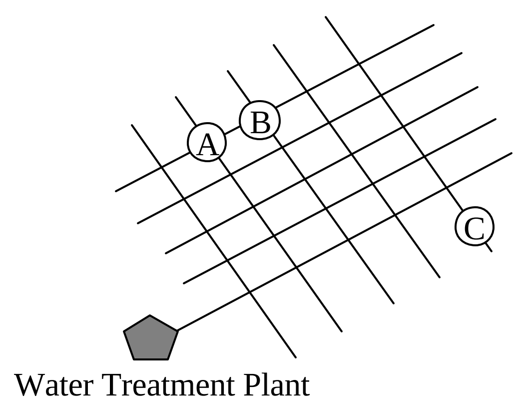
Selecting the High-HAA5 Site

Site C has the highest HAA5 LRAA. **Sites A** and **D** have almost as high HAA5 LRAAs. However, because Sites A and D have already been chosen as the high-TTHM sites, **Site C** is chosen as the high-HAA5 site.

Example 3.4 Providing Geographic Coverage when Choosing Stage 2B Sites

In general, the two representative highest TTHM sites (per plant) should not be from the same area of the distribution system. Consider the following example—

The two highest TTHM LRAAs in the distribution system are from adjacent historical sample sites (sites A and B). The site with the third highest TTHM LRAA is on the far side of the distribution system (site C). In this case, consider selecting sites **A and C** or **B and C** as Stage 2B sites for a broader geographical coverage of the distribution system.



Example 3.3 Maintaining an Historical Record

A 100% purchasing system serves 4,000 people and purchases all of its water. This system must select **two** Stage 2B compliance sites: one high-TTHM and one high-HAA5 site. The table below lists historical and Stage 1 DBPR compliance monitoring results for this system.

Sample Sites	**LRAA**	
	TTHM (µg/L)	**HAA5 (µg/L)**
Historical #1 (High TTHM)	*71*	*51*
Historical #2 (High TTHM)	65	45
Historical # 3 (High HAA5)	60	53
Stage 1 DBPR max residence time site	**69**	**51**

Because the TTHM LRAA for the Stage 1 DBPR site is only slightly lower than the maximum TTHM LRAA (Historical #1), the system chooses **the Stage 1 DBPR site over Historical #1** for the Stage 2B high TTHM site to maintain the historic DBP record at that site. **Historical #3** is selected as the high HAA5 site because this site has the highest HAA5 LRAA.

3.7 Reporting Results to the State

You are required to include your proposed Stage 2B compliance monitoring sites in your IDSE report. At a minimum, your IDSE report must include:

- A schematic of the distribution system
- All studies, reports, data, analytical results, and modeling to support your SSS
- All TTHM and HAA5 analytical results from Stage 1 DBPR compliance samples collected during the period of the IDSE
- Proposed Stage 2B compliance monitoring sites with justification for selection of each proposed site
- Proposed month(s) during which Stage 2B monitoring is to be conducted

Example reports for SSSs are in appendices to this manual, as listed in Table 3.3.

Table 3.3 Example IDSE Reports

Appendix	System Characteristics
Appendix K	SSS for a System Using a Hydraulic Model
Appendix L	SSS for a System Using Historical Data

4.0 Standard Monitoring Program Requirements for 100 Percent Purchasing Systems

4.1 Introduction

This chapter describes the Initial Distribution System Evaluation (IDSE) Standard Monitoring Program (SMP) requirements for 100 percent purchasing systems.[1] IDSE and Stage 2B Disinfectants and Disinfection Byproducts Rule (DBPR) monitoring requirements for 100 percent purchasing systems are based on population served and source water type, *not* on the number of plants as under the Stage 1 DBPR. Since these systems do not have treatment plants, a population-based monitoring program is more practical than the alternative method of determining the number of plants by the number of entry points.

The SMP requirements presented in this chapter include monitoring frequency, sample sites, and schedules. Chapter 8 builds on this chapter by describing how to select SMP monitoring sites. Chapter 8 also describes how SMP results are used to select Stage 2B DBPR compliance monitoring sites and lists the minimum requirements for the IDSE SMP report. The remainder of this chapter is organized as follows:

4.2 Schedule for Conducting the SMP
4.3 SMP Monitoring Requirements
4.4 Timing of Sample Collection
4.5 Sampling Protocol

Although some guidance in this chapter is appropriate for other system types, **this chapter solely addresses 100 percent purchasing systems**. Refer to Chapters 5 through 7 for guidance directed towards systems that produce some or all of their finished water.

4.2 Schedule for Conducting the SMP

All systems conducting the SMP must prepare an IDSE report. Systems must either submit their report [2 years after rule promulgation] if they are on the **early schedule**, or [4 years after rule promulgation] if they are on the **late schedule**. The schedule is based on population of the largest system in the combined distribution system.[2] Section 1.1 describes how systems determine when their IDSE report is due (i.e., if they are on the large or small system schedule).

[1] For the purposes of this manual, *100 percent purchasing systems* are those systems that buy or otherwise receive all of their finished water from one or more wholesale systems year-round.

[2] The Stage 2 DBPR defines a *combined distribution system* as the totality of the distribution systems of wholesale systems and of the consecutive systems that receive finished water from those wholesale systems (40 CFR 141.2).

It is recommended that systems begin SMP planning no later than 18 months before their IDSE report is due to the State. The 18 months allows for 3 months of planning, 12 months of SMP sampling, and 3 months for analyzing the final round of samples, reviewing the results, choosing the new compliance sites, and completing the IDSE report. Table 4.1 shows IDSE report due dates and the *latest* recommended SMP sampling start dates for systems on the early and late schedules.

Table 4.1 Consecutive System IDSE Report Schedule

Schedule Type[1]	IDSE Report Due Date[2]	Recommended SMP Sampling Start Date	Figure of Schedule (on next page)
Early Schedule	[2 years after rule promulgation]	No later than [9 months after rule promulgation]	Figure 4.1 Early System
Late Schedule	[4 years after rule promulgation]	No later than [2 years and 9 months after rule promulgation]	Figure 4.2 Late System

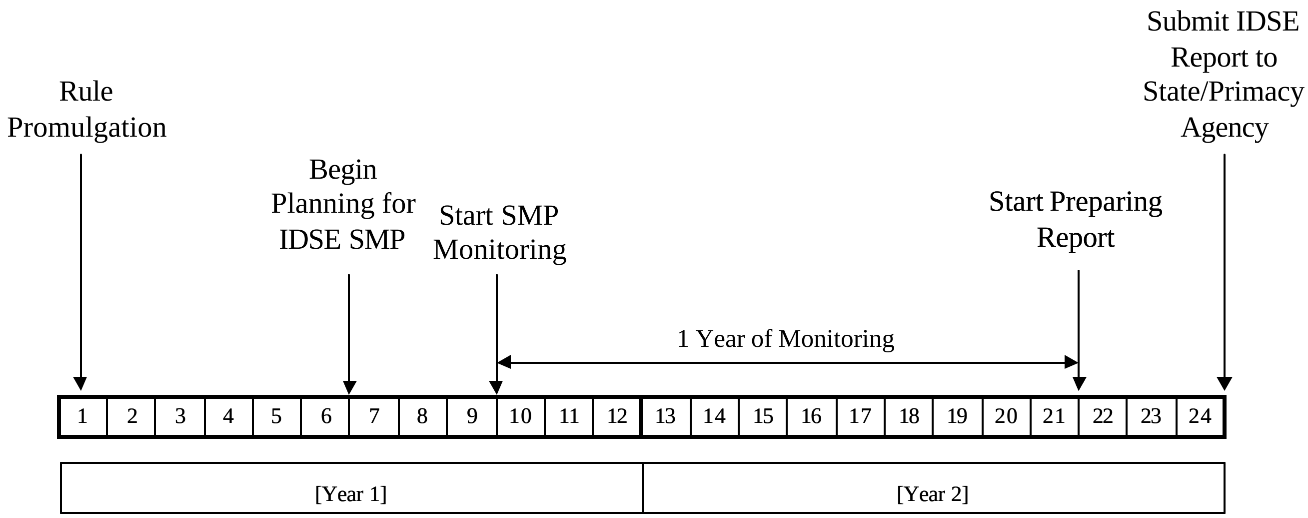
[1] See section 1.1 to determine your schedule type.
[2] 40 CFR 141.600(c).

To ensure smooth execution of an SMP, systems should begin planning several months (at least three months is recommended) before the first sample date. A written SMP sample plan must be prepared before systems begin sampling. An SMP plan must be submitted with the IDSE report and include, at a minimum:

- The number of required sample sites
- The specific site of all selected SMP sample sites
- The rationale for selection of SMP sample sites (not required, but recommended)
- A sampling schedule

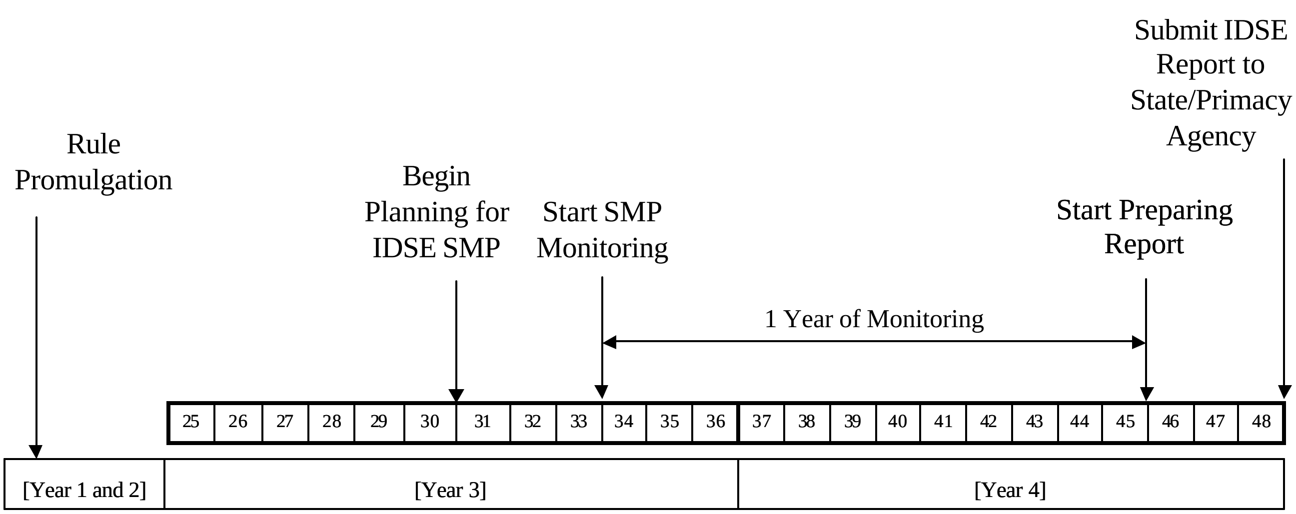
Figures 4.1 and 4.2 show the latest dates by which systems should begin planning, sampling, and preparing the report for an IDSE SMP. Figure 4.1 presents the early schedule and Figure 4.2 presents the late schedule.

Figure 4.1 Early Schedule for Conducting the IDSE SMP (Showing Latest Recommended Start Dates)



[Actual Timeline to be provided]

Figure 4.2 Late Schedule for Conducting the IDSE SMP (Showing Latest Recommended Start Dates)



[Actual Timeline to be provided]

4.3 SMP Monitoring Requirements

Stage 1 DBPR compliance monitoring sites **cannot** be used as SMP sites.

Table 4.2 summarizes the number of sites, sampling frequency, and total number of samples that must be collected for 100 percent purchasing surface and ground water systems[3] (40 CFR 141.602(a) and (b)). The number of sites and samples is based on the population of the system. All of a system's IDSE SMP samples must be dual samples sets, meaning one total trihalomethane (TTHM) and one five haloacetic acids (HAA5) sample that is taken at the same time and location. Chapter 8 provides guidance for selecting SMP sites to meet the requirements of the IDSE.

[3] For the purposes of this guidance manual, *surface water systems* are the same as subpart H systems—they use surface water or ground water under the direct influence of surface water (GWUDI) as a source. Surface water systems include all mixed systems (i.e., those that use surface and ground water). *Ground water systems* are those that use only ground water as a source.

Table 4.2 SMP Sampling Requirements for 100 Percent Purchasing Systems[1]

System Size (Population Served[3])	Number of Distribution System Sites (by location type) per System: Near Entry Point[4]	Average Residence Time	High TTHM	High HAA5	Total Number of Sites per System	Monitoring Frequency for the 1-year IDSE Period[5]
Surface Water Systems[6]						
< 500	-	-	1	1	**2**	Every 180 days
500 - 4,999	-	-	1	1	**2**	Every 90 days
5,000 - 9,999	-	1	2	1	**4**	Every 90 days
10,000 - 24,999	1	2	3	2	**8**	Every 60 days
25,000 - 49,999	2	3	4	3	**12**	Every 60 days
50,000 - 99,999	3	4	5	4	**16**	Every 60 days
100,000 - 499,999	4	6	8	6	**24**	Every 60 days
500,000 - < 1.5 million	6	8	10	8	**32**	Every 60 days
1.5 million - < 5 million	8	10	12	10	**40**	Every 60 days
≥ 5 million	10	12	14	12	**48**	Every 60 days
Ground Water Systems						
< 500	-	-	1	1	**2**	Every 180 days
500 - 9,999	-	-	1	1	**2**	Every 90 days
10,000 - 99,999	1	1	2	2	**6**	Every 90 days
100,000 - 499,999	1	1	3	3	**8**	Every 90 days
≥ 500,000	2	2	4	4	**12**	Every 90 days

1 (40 CFR 141.602 (b))
2 For the purposes of this manual, *100 percent purchasing systems* are those systems that buy or otherwise receive all of their finished water from one or more wholesale systems year-round.
3 *Population served* is typically a system's retail population. It should not include populations served by consecutive systems that purchase water from that system.
4 See section 8.2 for requirements when the number of entry points in a system is different from the number of required near-entry point sites in this table.
5 Monitoring frequency is the approximate number of days between monitoring events. A dual sample set must be collected at each location. A dual sample set is one TTHM and one HAA5 sample that is taken at the same time and location.
6 For the purpose of this guidance manual, "surface water systems" are equivalent to subpart H systems (i.e., any system that uses surface water or GWUDI as a source, including all mixed systems that use some surface water or GWUDI and some ground water).

4.4 Timing of Sample Collection

A system's monitoring schedule must be determined using historical disinfection byproduct (DBP) data or temperature data (40 CFR 141.602(a)). DBP data should be used as the primary indicator, and then temperature data if DBP data are not sufficient. The month with the highest TTHM or HAA5 concentration (whichever of the two is highest) or maximum temperature is referred to as the *controlling month.*

Systems may select any date in the controlling month to sample and should consider dates when staff are available to collect samples. The other rounds of sampling must be scheduled around the controlling month at the required sampling frequency listed in Table 4.2. The sampling dates for the entire year must be scheduled and documented in the system's sampling plan before collecting the first sample. Systems can select a start date prior to the controlling month provided the controlling month is included in their schedule. Figure 4.3 and Table 4.3 provides an example of how to select the controlling month using hypothetical distribution system data.

Figure 4.3 Example Historic DBP and Temperature Data

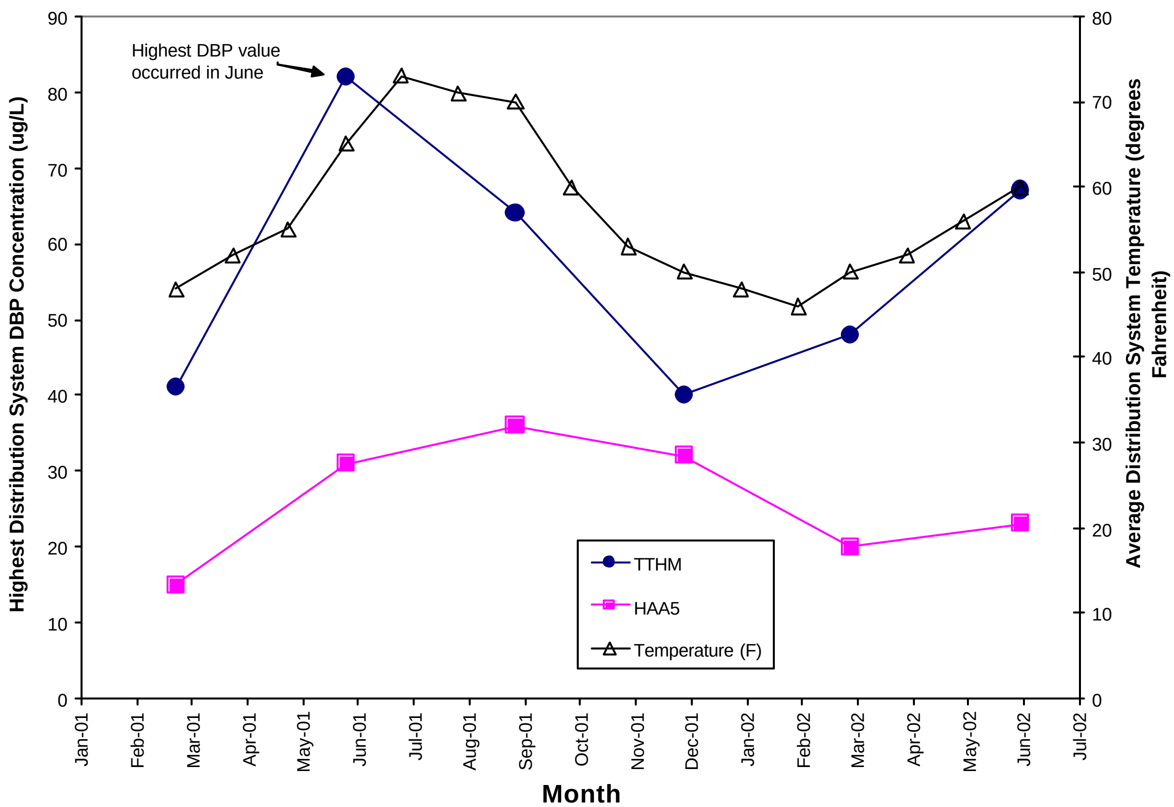


Table 4.3 Example of Historic DBP and Temperature Data

Month	TTHM (µg/L)	HAA5 (µg/L)	Average Distribution System Temp. (F)
Mar. 2001	41	15	48
Apr. 2001			52
May 2001			55
June 2001	**82**	**31**	**65**
July 2001			73
Aug. 2001			71
Sept. 2001	64	36	70
Oct. 2001			60
Nov. 2001			53
Dec. 2001	40	32	50
Jan. 2002			48
Feb. 2002			46
Mar. 2002	45	50	50
Apr. 2002			52
May 2002			56
June 2002	67	23	60

In this example, the highest DBP level was the TTHM value from June 2001. Therefore the controlling month is June and the IDSE SMP sampling must be scheduled to include that month. If no DBP data were available, July would have been selected as the controlling month because it has the highest average distribution system temperature.

In the example, if the system must monitor quarterly, using the data in Figure 4.3 and Table 4.3 the four sampling dates should be scheduled approximately every 90 days considering June as the controlling month as follows:

- First Tuesday in March 2003
- First Tuesday **in June 2003** (controlling month)

- First Tuesday in September 2003
- First Tuesday in December 2003

Chloramine systems that routinely convert to free chlorine for a "burnout period" must still set their schedules according to the highest DBP (or temperature) month (40 CFR 141.602(a)), regardless of whether chloramine or free chlorine is used during the controlling month.

SMP samples should be collected as scheduled. EPA recognizes extenuating circumstances can occur that may delay sampling (e.g., an ice storm). Any deviations from the scheduled sampling days must be noted in the IDSE report (40 CFR 141.604(a)).

4.5 Sampling Protocol

Generally, it is best to collect samples in the morning to allow the samples to be packed and shipped the same day if systems are sending them to a contract laboratory. Samples should be collected in a manner that ensures they are representative of the water in the distribution system at that sampling point. If sampling from indoor plumbing, samples should be collected from the cold water line. The line between the sample tap or faucet and the distribution system should be flushed. This can usually be accomplished by opening the faucet where the sample is collected and allowing the water to run for a few minutes. When the water temperature stabilizes, this indicates fresh water from the distribution system is being obtained.

The sample bottles should contain appropriate dechlorinating agents/preservatives prior to filling. Sampling and storage protocols outlined in the approved analytical methods must be followed. Contact the laboratory analyzing the samples for their recommended sampling and preservation protocols. Appendix C provides more detailed information on sampling procedures and approved sampling methods. Samples must be analyzed by laboratories that have received certification by EPA or the State.

If a sample is lost or broken, take a replacement sample as soon as possible. Systems only need to resample for the lost sample bottle; they do not need to resample the entire set. For example, if a TTHM sample is broken during shipping, the system would resample only for TTHM as soon as possible at the given site. Make sure to note the deviation in sampling schedule for this sample in the IDSE report.

Sampling near Fire Hydrants

Fire hydrants or blow-offs in locations that could impact the water reaching a sampling point should not be flushed prior to the collection of the DBP samples, because that could significantly change the "age" of the water being sampled. The intent of the DBP sampling effort is to obtain water that is representative of what the customers normally receive.

Guidance Manual Navigation

Continue to Chapter 8—*SMP Site Selection*

5.0 Standard Monitoring Program Requirements for:

Producing Surface Water Systems Serving at Least 10,000 People

5.1 Introduction

This chapter describes the Initial Distribution System Evaluation (IDSE) Standard Monitoring Program (SMP) requirements for producing surface water systems[1, 2] serving at least 10,000 people. These requirements include monitoring frequency, sample sites, and scheduling. Chapter 8 builds on this chapter by describing how final SMP monitoring sites should be selected using various sources and tools. Chapter 8 also describes how SMP results are used to select Stage 2B Disinfectants and Disinfection Byproducts Rule (DBPR) compliance monitoring sites and lists the minimum requirements for the IDSE SMP report. The remainder of this section is organized as follows:

5.2 Schedule for Conducting the SMP
5.3 Number of Samples Required
5.4 Sample Site Requirements
5.5 Timing of SMP Sample Collection
5.6 Sampling Protocol

Although some guidance in this chapter is appropriate for other system types and sizes, **this chapter specifically addresses producing surface water systems serving at least 10,000 people**. Refer to Chapters 6 and 7 for guidance directed towards other producing system types. Refer to Chapter 4 for guidance directed towards 100 percent purchasing systems.

5.2 Schedule for Conducting the SMP

All surface water systems serving at least 10,000 people are on the **large system schedule** and must submit their IDSE report [2 years after rule promulgation]. It is recommended that systems begin planning their SMP <u>no later than</u> [6 months after rule promulgation]. The 18 months includes 3 months for planning, 12 months of SMP sampling, and 3 months to analyze the final round of samples, review the results, choose the new compliance sites, and complete the IDSE report.

[1] For the purpose of this guidance manual, *producing systems* are those that do not buy 100 percent of their water year-round (i.e., they produce some or all of their own finished water). See Chapter 1 for additional guidance on classifying systems.

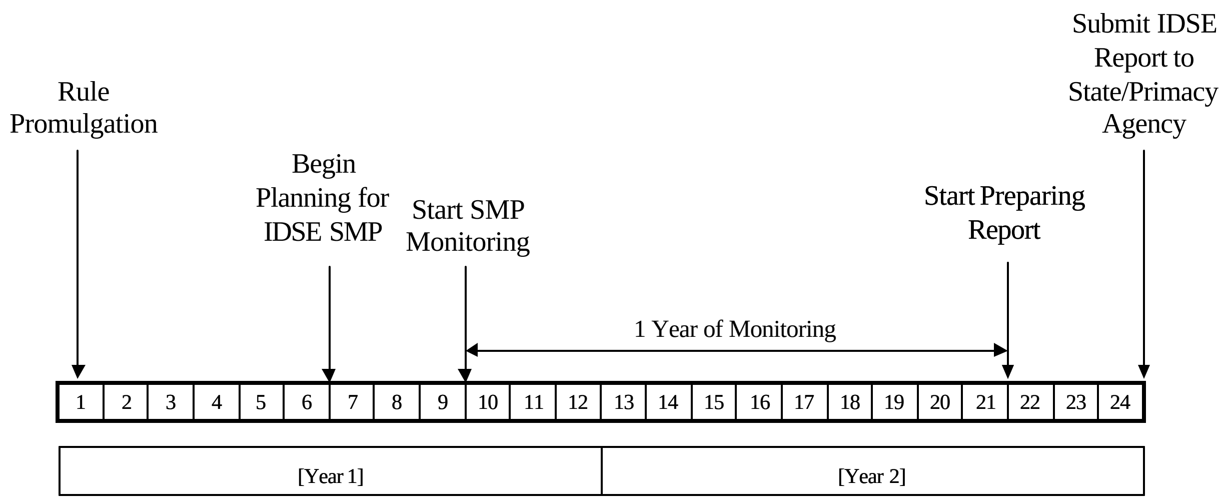
[2] For the purposes of this guidance manual, *surface water systems* are the same as “subpart H” systems—they use surface water or ground water under the direct influence of surface water (GWUDI) as a source. Surface water systems include all mixed systems (i.e., those that use surface and ground water). *Ground water systems* are those that use only ground water as a source.

To ensure smooth execution of an SMP, systems should begin planning several months (at least three months is recommended) before the first sample date. A written SMP sample plan must be prepared before beginning sampling. The plan must be submitted with the IDSE report and include, at a minimum:

- The number of required sample sites
- The specific site of all selected SMP sample sites
- The rationale for selection of SMP sample sites (not required but recommended)
- A sampling schedule

Figure 5.1 shows the *latest* recommended dates by which systems should begin planning, sampling, and preparing the report for an SMP to meet regulatory requirements.

Figure 5.1 Large System Schedule for Conducting the SMP (Showing Latest Recommended Start Dates)



[Actual Timeline to be provided]

5.2.1 Consecutive Water Systems and Wholesalers

The IDSE SMP report is due at the same time as that of the largest system in the combined distribution system. Therefore, if a small system serving less than 10,000 people buys water from a system serving at least 10,000 people, they must submit their report on the large system schedule, or [2 years after rule promulgation]. EPA recommends that systems share information about their IDSE report schedule with all wholesale purchasers of their water. Coordination with systems that purchase water from systems serving at least 10,000 people is not required, but is strongly recommended.

5.3 Number of Samples Required

Producing surface water systems serving at least 10,000 people must collect samples **every 2 months over a 1 year period**. Samples must be collected at **eight sites per plant** and analyzed for total trihalomethanes (TTHM) and five haloacetic acids (HAA5). These sites must be different than the Stage 1 DBPR compliance monitoring sites. All systems' IDSE SMP samples must be dual samples sets, meaning one TTHM and one HAA5 sample that is taken at the same time and location. For a system with one plant, a total of **48 dual sample sets** are required during the 1-year monitoring period (see the illustration below).

8 Sites per plant × 6 Sample Periods = 48 Dual Samples Sets

Section 1.1 provides guidelines for estimating the number or plants in a system.

*****Examples for Determining Number of Plants, Sites, and Samples*****

Example 5.1

A system serving 100,000 people operates one surface water treatment plant and receives water from two disinfecting ground water systems, at separate entry points, for more than60 consecutive days per year.

Total plants: 3 (one surface water and two ground water)
Total SMP sites: 8 sites per plant × 3 plants = 24 sites
Total Samples: 24 sties × 6 sample periods = 144 dual samples

Example 5.2

A system serving 35,000 people purchases treated surface water through one entry point and has three wells. Chlorine is added at each well site. The State determined that two of the wells draw from the same aquifer and that the third well draws from a different aquifer.

Total plants: 3 (one for the purchased water entry point, the second for the two wells drawing from the same aquifer, and the third for the well drawing from another aquifer)
Total sites: 8 sites per plant × 3 plants = 24 sites
Total Samples: 24 sites × 6 sample periods = 144 dual samples

Example 5.3

A system serves 90,000 people, purchases treated water from one wholesaler, through five entry points, and has two wells which they use on a daily basis. The wholesaler has three surface water treatment plants. Three of the entry points receive water from plant A and two of the entry points receive water from plant B. The State-approved multiple consecutive entry points to be considered as one plant—the three entry points receiving water from plant A are one plant and the two entry points receiving water from plant B are a second plant. The two wells feed into one pumphouse where chlorine is added; this is considered one treatment plant.

Total plants: 3 (two plants for the consecutive entry points and one ground water)
Total SMP sites: 8 sites per plant × 3 plants = 24 sites
Total Samples: 24 sites × 6 sample periods = 144 dual samples

5.4 Sample Site Requirements

Stage 1 DBPR compliance monitoring sites **cannot** be used as SMP sites.

Sample site requirements depend on a system's residual disinfectant type. Table 5.1 summarizes the SMP site requirements for producing surface water systems serving at least 10,000 people. The required SMP sample sites listed in Table 5.1 are *in addition to* Stage 1 DBPR compliance monitoring sites. Chapter 8 describes how real entry point sites are selected for chlorine and chloramine systems and provides guidance for selecting all other SMP sites to meet the requirements of the IDSE.

Table 5.1 SMP Sample Sites for Producing Surface Water Systems Serving at Least 10,000 People

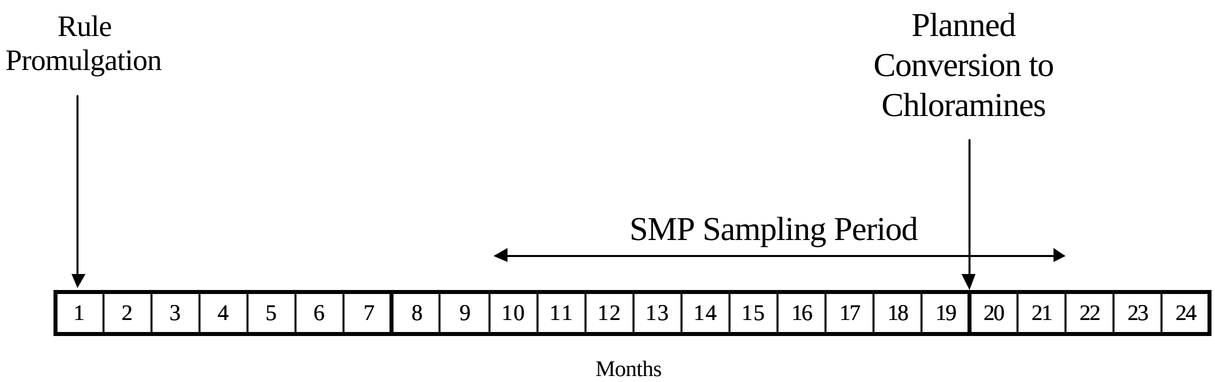
Residual Disinfectant Type	Number of SMP Sample Sites Required per Plant				
	Near Entry Point	Average Residence Time	High TTHM	High HAA5	Total Dual Samples per Plant
Chlorine	1	2	3	2	8
Chloramines	2	2	2	2	8

5.4.1 Changing Disinfectants During the SMP Period

If systems anticipate a change in residual disinfectant during the 1-year SMP sampling period, selection of SMP sites should be based on the disinfectant expected to be in use at the end of the sampling period. Figure 5.2 shows an example timeline where a system uses free chlorine at the start of the SMP, but changes to chloramines before the end of the SMP sampling period. In this case, sample site selection should be performed as required for chloraminated systems. Thus, two sample sites (instead of one) near the entry point and four sites (instead of five) representative of highest TTHM and HAA5 should be selected. In both cases, two average residence time sites are required.

If systems are unsure as to whether their disinfectant conversion will take place during the SMP sampling period, they should select sites based on SMP requirements for a *chlorine* system.

Figure 5.2 Planned Conversion to Chloramines



SMP must be based on chloramine requirements.

5.5 Timing of SMP Sample Collection

A system's monitoring schedule must be determined using historical disinfection byproduct (DBP) data or temperature data (40 CFR 141.602(a)). DBP data should be used as the primary indicator, and then temperature data if DBP data are not sufficient. The month with the highest TTHM or HAA5 concentration (whichever of the two is highest) or maximum temperature is referred to as the *controlling month*.

Systems may select any date in the controlling month to sample and should consider dates when staff are available to collect samples. The other rounds of sampling must be scheduled around the controlling month at two month intervals. The sampling dates for the entire year must be scheduled and documented in the system's sampling plan before collecting the first sample. Systems can select a start date prior to the controlling month provided the controlling month is included in their schedule. Figure 5.3 and Table 5.2 provides an example of how to select the controlling month using hypothetical distribution system data.

Figure 5.3 Example Historic DBP and Temperature Data

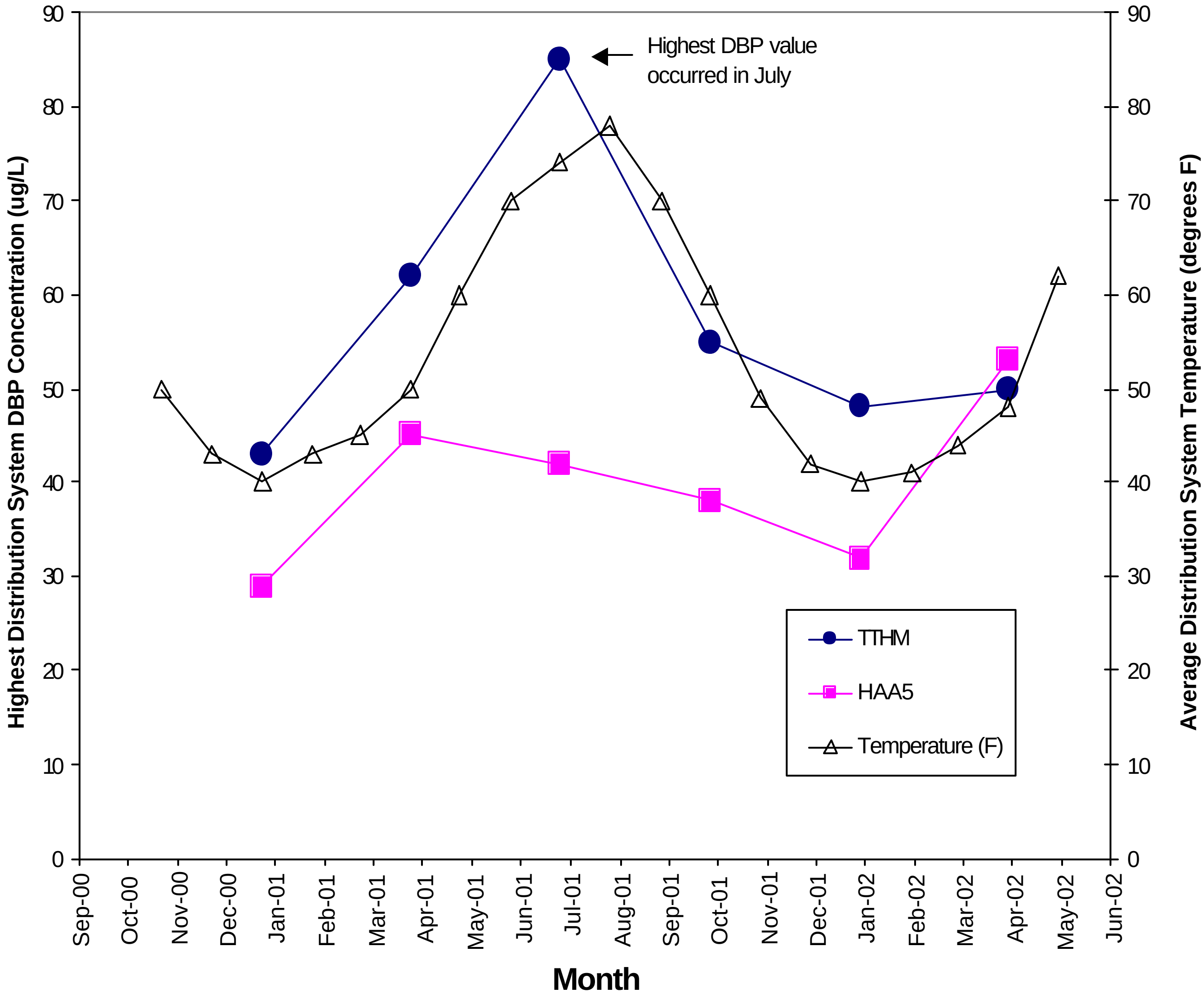


Table 5.2 Example of Historic DBP and Temperature Data

Month	TTHM (µg/L)	HAA5 (µg/L)	Average Distribution System Temp. (F)
Nov. 2000			50
Dec. 2000			43
Jan 2001	43	29	40
Feb 2001			43
Mar. 2001			45
Apr. 2001	62	45	50
May 2001			60
June 2001			70
July 2001	**85**	**42**	**74**
Aug. 2001			78
Sept.2001			70
Oct. 2001	55	38	60
Nov. 2001			49
Dec. 2001			42
Jan. 2002	48	32	40
Feb. 2002			41
Mar. 2002			44
Apr. 2002	50	53	48
May 2002			62

In this example, the highest DBP level was the TTHM value from July 2001. Therefore, the controlling month is July and the SMP sampling must be scheduled considering that month. If no DBP data were available, August would have been selected as the controlling month because it has the highest average distribution system temperature.

For the example in Figure 5.3 and Table 5.2, the six sampling dates should be scheduled approximately every 60 days with July as the controlling month as follows:

- First Thursday in March 2003
- First Thursday in May 2003
- First Thursday **in July 2003** (controlling month)
- First Thursday in September 2003
- First Thursday in November 2003
- First Thursday in January 2004

Chloramine systems that routinely convert to free chlorine for a “burnout period” must still set their schedules according to the highest DBP (or temperature) month (40 CFR 141.602(a)), regardless of whether chloramine or free chlorine is used during the controlling month.

SMP samples should be collected as scheduled. EPA recognizes extenuating circumstances can occur that may delay sampling (e.g., an ice storm). Any deviations from the scheduled sampling days must be noted in the IDSE report (40 CFR 141.604(a)).

5.6 Sampling Protocol

Generally, it is best to collect samples in the morning to allow the samples to be packed and shipped the same day if systems are sending them to a contract laboratory. Samples should be collected in a manner that ensures they are representative of the water in the distribution system at that sampling point. If sampling from indoor plumbing, samples should be collected from the cold water line. The line between the sample tap or faucet and the distribution system should be flushed. This can usually be accomplished by opening the faucet where the sample is collected and allowing the water to run for a few minutes. When the water temperature stabilizes, this indicates fresh water from the distribution system is being obtained.

The sample bottles should contain appropriate dechlorinating agents/preservatives prior to filling. Sampling and storage protocols outlined in the approved analytical methods must be followed. Contact the laboratory analyzing the samples for their recommended sampling and preservation protocols. Appendix C provides more detailed information on sampling procedures and approved sampling methods. Samples must be analyzed by laboratories that have received certification by EPA or the State.

If a sample is lost or broken, take a replacement sample as soon as possible. Systems need to resample only for the lost sample bottle; they do not need to resample the entire set. For example, if a TTHM sample is broken during shipping, systems would resample only for TTHM as soon as possible at the given site. Make sure to note the deviation in sampling schedule for this sample in the IDSE report.

Sampling near Fire Hydrants

Fire hydrants or blow-offs in locations that could impact the water reaching a sampling point should not be flushed prior to the collection of the DBP samples, because that could significantly change the "age" of the water being sampled. The intent of the DBP sampling effort is to obtain water that is representative of what the customers normally receive.

Guidance Manual Navigation

Continue to Chapter 8—*SMP Site Selection*

6.0 Standard Monitoring Program Requirements for:

Producing Surface Water Systems Serving 500 to 9,999 People
or
Producing Ground Water Systems Serving at Least 10,000 People

6.1 Introduction

This chapter describes the Initial Distribution System Evaluation (IDSE) Standard Monitoring Program (SMP) requirements for producing surface water systems [1, 2] serving 500 to 9,999 people and producing ground water systems serving at least 10,000. These requirements include monitoring frequency, sample sites, and schedules. Chapter 8 builds on this chapter by describing how to select SMP monitoring sites. Chapter 8 also describes how SMP results are used to select Stage 2B Disinfectants and Disinfection Byproducts Rule (DBPR) compliance monitoring sites and lists the minimum requirements for the IDSE SMP report. The remainder of this chapter is organized as follows:

6.2 Schedule for Conducting the SMP
6.3 SMP Monitoring Requirements
6.4 Timing of Sample Collection
6.5 Sampling Protocol

Although some guidance in this chapter is appropriate for other system types and sizes, this chapter specifically addresses **producing surface water systems serving 500 to 9,999 people and producing ground water systems serving at least 10,000 people**. 100 percent purchasing systems should refer to Chapter 4, and producing systems of other source water types and system sizes should refer to Chapters 5 and 7.

---

[1] For the purpose of this guidance manual, *producing systems* are those that do not buy 100 percent of their water year-round (i.e., they produce some or all of their own finished water). See Chapter 1 for additional guidance on classifying systems.

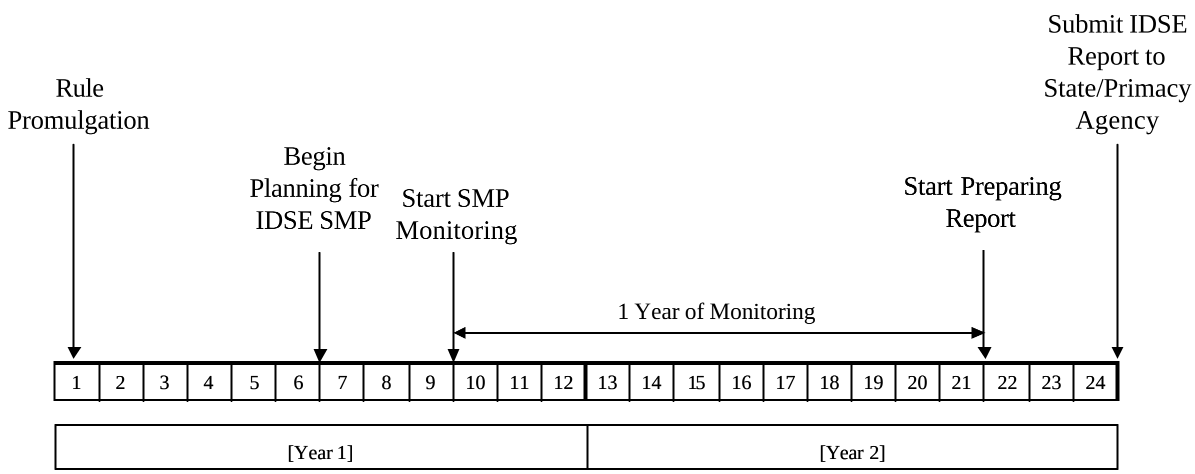
[2] For the purposes of this guidance manual, *surface water systems* are the same as “subpart H” systems—they use surface water or ground water under the direct influence of surface water (GWUDI) as a source. Surface water systems include all mixed systems (i.e., those that use surface and ground water). *Ground water systems* are those that use only ground water as a source.

6.2 Schedule for Conducting the SMP

All systems conducting the SMP must prepare an IDSE report. Systems must either submit their report [2 years after rule promulgation] if they are on the **large system schedule**, or [4 years after rule promulgation] if they are on the **small system schedule**. The schedule is based on population of the largest system in the combined distribution system.[3] Section 1.4 describes how systems determine when their IDSE report is due (i.e., if they are on the large or small system schedule).

It is recommended that systems begin planning the SMP no later than 18 months before the IDSE report is due to the State. The 18 months includes 3 months of planning, 12 months of SMP sampling, and 3 months for analyzing the final round of samples, reviewing the results, choosing the new compliance sites, and completing the IDSE report. Figures 6.1 and 6.2 show the *latest* recommended dates by which systems should begin planning, sampling, and preparing the report for an SMP to meet regulatory requirements. Figure 6.1 represents the large system schedule and Figure 6.2 represents the small system schedule.

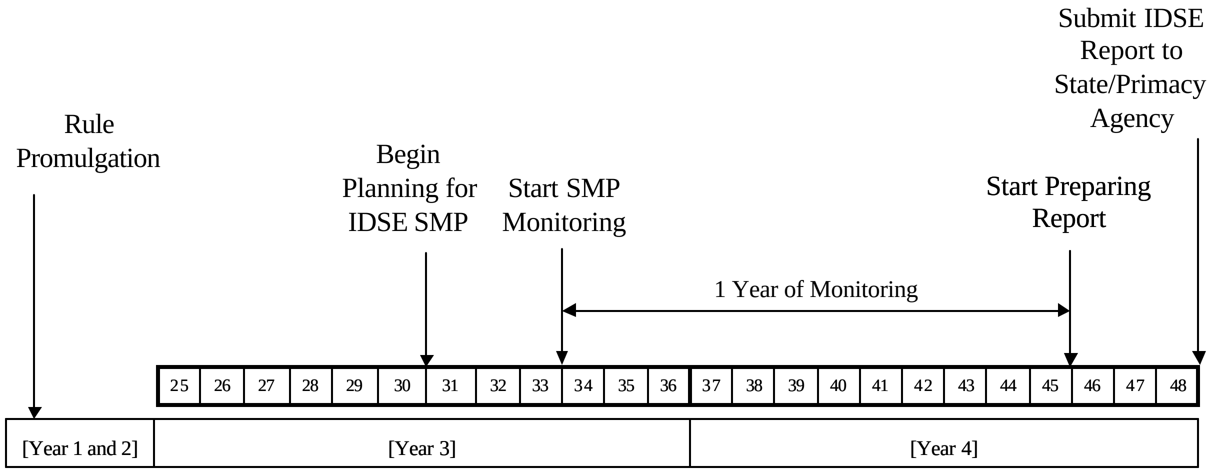
Figure 6.1 Large System Schedule for Conducting the IDSE SMP (Showing Latest Recommended Start Dates)



[Actual Timeline to be provided]

[3] The Environmental Protection Agency (EPA) defines a *combined distribution system* as the totality of the distribution systems of wholesale systems and of the consecutive systems that receive finished water from those wholesale systems.

Figure 6.2 Small System Schedule for Conducting the IDSE SMP (Showing Latest Recommended Start Dates)



[Actual Timeline to be provided]

A written SMP sample plan must be prepared before systems begin sampling. The plan must be submitted with the IDSE report and include, at a minimum:

- The number of required sample sites
- The specific site of each selected SMP sample site
- The rationale for selection of SMP sample sites (not required, but recommended)
- A sampling schedule

6.3 SMP Monitoring Requirements

> Stage 1 DBPR compliance monitoring sites **cannot** be used as SMP sites.

Table 6.1 summarizes the number of sites, sampling frequency, and total number of samples that must be collected **per plant** in a system (this sampling requirement is in addition to the Stage 1 DBPR compliance monitoring). All of a system's IDSE SMP samples must be dual sample sets, meaning one total trihalomethane (TTHM) and one five haloacetic acids (HAA5) sample that is taken at the same time and location. The SMP sample sites are *in addition to*

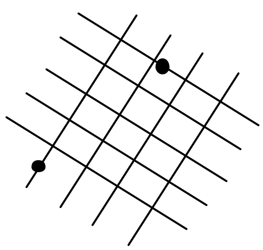
Stage 1 DBPR compliance monitoring sites (40 CFR 141.602(a)). Chapter 8 provides guidance for selecting SMP sites to meet the requirements of the IDSE.

Table 6.1 Summary of SMP Sampling Requirements[1]

Source Type and Population Served	Number of Sites	Sampling Frequency	Total Dual Samples per Plant
Surface Water (500 - 9,999) and Ground Water (≥ 10,000)	2 per plant—1 high TTHM and 1 high HAA5	every 3 months for 1 year	8

[1] 40 CFR 141.602(a))

For producing surface water systems serving 500 to 9,999 people and ground water systems serving at least 10,000 people and having one plant, a total of 8 dual sample sets is required, and each must be analyzed for TTHM and HAA5 (see the illustration below).



Approximately Every 90 Days

TTHM

HAA5

2 Sites per Plant × 4 Sample Periods = 8 Dual Samples Sets

Section 1.1 provides guidelines for estimating the number or plants in a system.

*****Examples for Determining Number of Plants, Sites, and Samples*****

Example 6.1

A system serving 6,000 people operates one surface water treatment plant and receives water from two other surface water systems, at separate entry points, for more than 60 consecutive days per year.

Total plants: 3 (one surface water and two consecutive entry points)
Total SMP sites: 2 sites per plant × 3 plants = 6 sites
Total samples: 6 sites × 4 monitoring periods = 24 dual sample sets

Example 6.2

A system serves 5,000 people, purchases treated surface water through one entry point, and has three wells. Chlorine is added at each well site. The State determined that two of the wells draw from the same aquifer and that the third well draws from a different aquifer.

Total plants: 3 (one for the purchased water entry point, the second for the two wells drawing from the same aquifer, and the third for the well drawing from another aquifer)
Total sites: 2 sites per plant × 3 plants = 6 sites
Total samples: 6 sites × 4 monitoring periods = 24 dual sample sets

Example 6.3

A system serves 25,000 people, purchases treated ground water from one wholesaler, through five entry points, and has two wells. The State approved multiple consecutive entry points to be considered as one plant—the three entry points receiving water from plant A are one plant and the two entry points receiving water from plant B are a second plant. The two wells feed into one pumphouse where chlorine is added; this is considered one treatment plant.

Total plants: 3 (two plants for the consecutive entry points and one ground water)
Total SMP sites: 2 sites per plant × 3 plants = 6 sites
Total samples: 6 sites × 4 monitoring periods = 24 dual sample sets

6.4 Timing of Sample Collection

A system's monitoring schedule must be determined using historical disinfection byproduct (DBP) data or temperature data (40 CFR 141.602(a)). DBP data should be used as the primary indicator, and then temperature data if DBP data are not sufficient. The month with the highest TTHM or HAA5 concentration (whichever of the two is highest) or maximum temperature is referred to as the *controlling month.*

Systems may select any date in the controlling month to sample and should consider dates when staff are available to collect samples. The other rounds of sampling must be scheduled around the controlling month at three month intervals. The sampling dates for the entire year must be scheduled and documented in a system's sampling plan before collecting the first sample. Systems can select a start date prior to the controlling month provided the controlling month is included in their schedule. Figure 6.3 and Table 6.2 provide an example of how to select the controlling month using hypothetical distribution system data.

Figure 6.3 Example Historic DBP and Temperature Data

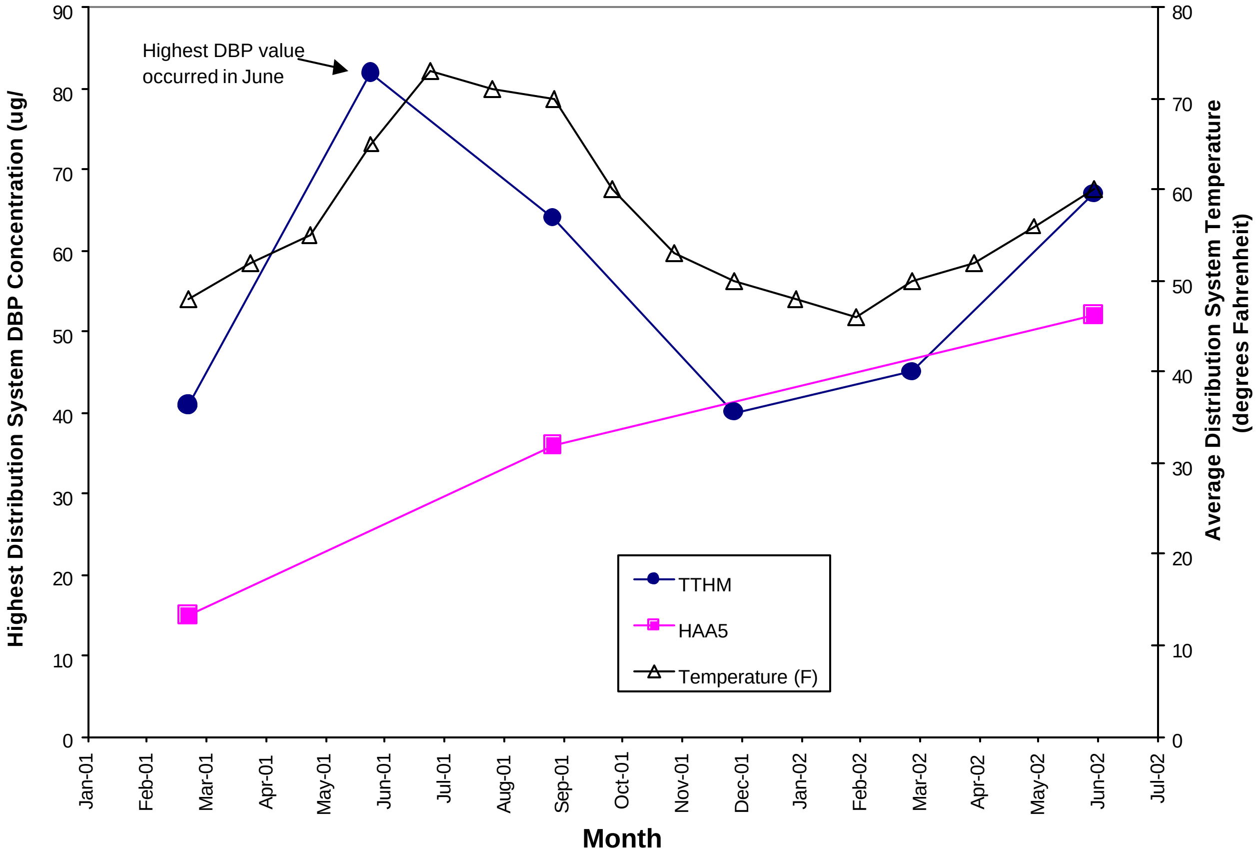


Table 6.2 Example of Historic TTHM and Temperature Data

Month	TTHM (µg/L)	HAA5 (µg/L)	Average Distribution System Temp. (F)
Mar. 2001	41	15	48
Apr. 2001			52
May 2001			55
June 2001	**82**	**31**	**65**
July 2001			73
Aug. 2001			71
Sept. 2001	64	36	70
Oct. 2001			60
Nov. 2001			53
Dec. 2001	40	32	50
Jan. 2002			48
Feb. 2002			46
Mar. 2002	45	50	50
Apr. 2002			52
May 2002			56
June 2002	67	23	60

In this example, the highest DBP level was the TTHM value from June 2001. Therefore, the controlling month is June and the SMP sampling must be scheduled to include that month. If no DBP data were available, July would have been selected as the controlling month because it has the highest average distribution system temperature.

In the example, if the system must monitor quarterly, using the data in Figure 6.3 and Table 6.2, the four sampling dates should be scheduled approximately every 90 days considering June as the controlling month as follows:

- First Monday in March 2003
- First Monday **in June 2003** (controlling month)

- First Monday in September 2003
- First Monday in December 2003

Chloramine systems that routinely convert to free chlorine for a "burnout period" must still set their schedules according to the highest DBP (or temperature) month (40 CFR 141.602(a)), regardless of whether chloramine or free chlorine is used during the controlling month.

SMP samples should be collected as scheduled. EPA recognizes extenuating circumstances can occur that may delay sampling (e.g., an ice storm). Any deviations from the scheduled sampling days must be noted in the IDSE report (40 CFR 141.604(a)).

6.5 Sampling Protocol

Generally, it is best to collect samples in the morning to allow the samples to be packed and shipped the same day if systems are sending them to a contract laboratory. Samples should be collected in a manner that ensures they are representative of the water in the distribution system at that sampling point. If sampling from indoor plumbing, samples should be collected from the cold water line. The line between the sample tap or faucet and the distribution system should be flushed. This can usually be accomplished by opening the faucet where the sample is collected and allowing the water to run for a few minutes. When the water temperature stabilizes, this indicates fresh water from the distribution system is being obtained.

The sample bottles should contain appropriate dechlorinating agents/preservatives prior to filling. Sampling and storage protocols outlined in the approved analytical methods must be followed. Contact the laboratory analyzing the samples for their recommended sampling and preservation protocols. Appendix C provides more detailed information on sampling procedures and approved sampling methods. Samples must be analyzed by laboratories that have received certification by EPA or the State.

If a sample is lost or broken, take a replacement sample as soon as possible. Systems need to resample only for the lost sample bottle; they do not need to resample the entire set. For example, if a TTHM sample is broken during shipping, the system would resample only for TTHM as soon as possible at the given site. Make sure to note the deviation in sampling schedule for this sample in the IDSE report.

Sampling near Fire Hydrants

Fire hydrants or blow-offs in sites that could impact the water reaching a sampling point should not be flushed prior to the collection of the DBP samples, because that could significantly change the "age" of the water being sampled. The intent of the DBP sampling effort is to obtain water that is representative of what the customers normally receive.

Guidance Manual Navigation

Continue to Chapter 8—*SMP Site Selection*

7.0 Standard Monitoring Program Requirements for:

Producing Surface Water Systems Serving Less Than 500 People or Producing Ground Water Systems Serving Less Than 10,000 People

7.1 Introduction

This chapter describes the Initial Distribution System Evaluation (IDSE) Standard Monitoring Program (SMP) requirements for producing surface water systems[1, 2] serving less than 500 people and producing ground water systems serving less than 10,000 people. These requirements include monitoring frequency, sample sites, and schedules. Chapter 8 builds on this chapter by describing how to select SMP monitoring sites. Chapter 8 also describes how SMP results are used to select Stage 2B Disinfectants and Disinfection Byproducts Rule (DBPR) compliance monitoring sites and lists the minimum requirements for the IDSE SMP report. The remainder of this chapter is organized as follows:

7.2 Schedule for Conducting the SMP
7.3 Number of Samples Required
7.4 Sample Site Requirements
7.5 Timing of Sample Collection
7.6 Sampling Protocol

Although some guidance in this chapter is appropriate for other system types and sizes, this chapter specifically addresses **producing surface water systems serving less than 500 people and producing ground water systems serving less than 10,000 people**. 100 percent purchasing systems should refer to Chapter 4, and producing systems of other source water types and system sizes should refer to Chapters 5 and 6.

---

[1] For the purpose of this guidance manual, *producing systems* are those that do not buy 100 percent of their water year-round (i.e., they produce some or all of their own finished water). See Chapter 1 for additional guidance on classifying systems.

[2] For the purposes of this guidance manual, *surface water systems* are the same as "subpart H" systems—they use surface water or ground water under the direct influence of surface water (GWUDI) as a source. Surface water systems include all mixed systems (i.e., those that use surface and ground water). *Ground water systems* are those that use only ground water as a source.

7.2 Schedule for Conducting the SMP

All systems conducting the SMP must prepare an IDSE report. Systems must either submit their report [2 years after rule promulgation] if they are on the **large system schedule**, or [4 years after rule promulgation] if they are on the **small system schedule**. The schedule is based on population of the largest system in the combined distribution system.[3] Section 1.4 describes how systems determine when their IDSE report is due (i.e., if they are on the large or small system schedule).

It is recommended that systems begin planning the SMP no later than 18 months before the IDSE report is due to the State. The 18 months includes 3 months of planning, 12 months of SMP sampling, and 3 months for analyzing the final round of samples, reviewing the results, choosing the new compliance sites, and completing the IDSE report. Table 7.1 shows IDSE report due dates and the *latest* recommended SMP sampling start dates for systems on the small and large system schedules.

Table 7.1 IDSE Report Schedule

Schedule Type	IDSE Report Due Date	Recommended SMP Sampling Start Date	Figure of Schedule (on next page)
Large System Schedules	[2 years after rule promulgation]	No later than [9 months after rule promulgation]	Figure 7.1 Large System
Small System Schedule	[4 years after rule promulgation]	No later than [2 years and 9 months after rule promulgation]	Figure 7.2 Small System

Note: See section 1.4 to determine the schedule type.

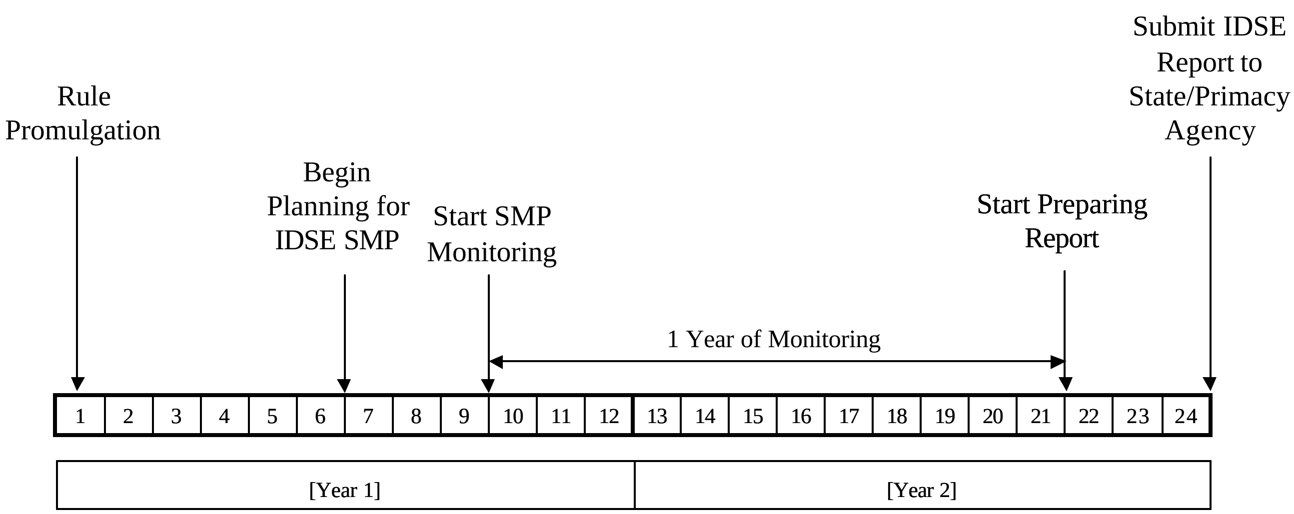
[3] The Environmental Protection Agency (EPA) defines a *combined distribution system* as the totality of the distribution systems of wholesale systems and of the consecutive systems that receive finished water from those wholesale systems.

To ensure smooth execution of an SMP, systems should begin planning several months (at least three months is recommended) before the first sample date. A written SMP sample plan must be prepared before systems begin sampling. The plan must be submitted with the IDSE report and include, at a minimum:

- The number of required sample sites
- The specific site of all selected SMP sample sites
- The rationale for selection of SMP sample sites (not required, but recommended)
- A sampling schedule

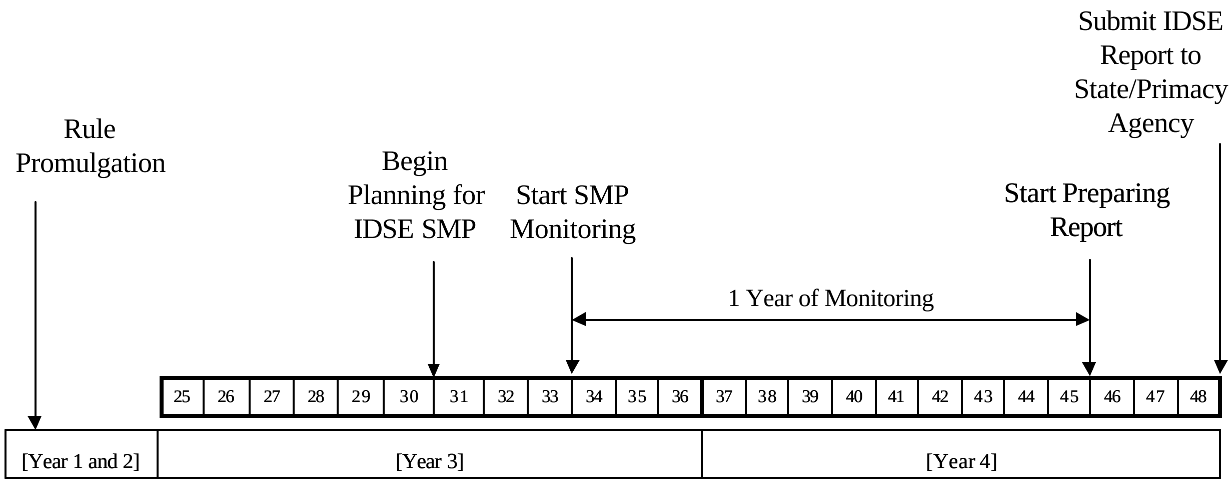
Figures 7.1 and 7.2 show the latest dates by which systems should begin planning, sampling, and preparing the report for an SMP to meet regulatory requirements. Figure 7.1 represents the schedule for consecutive systems with a large system in the combined distribution system and Figure 7.2 represents the small system schedule.

Figure 7.1 Large System Schedule for Conducting the IDSE SMP (Showing Latest Recommended Start Dates)



[Actual Timeline to be provided]

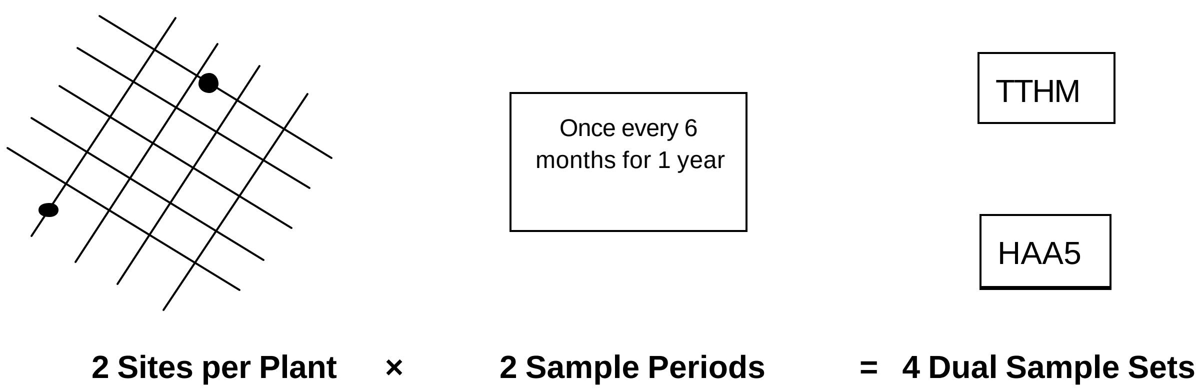
Figure 7.2 Small System Schedule for Conducting the IDSE SMP (Showing Latest Recommended Start Dates)



[Actual Timeline to be provided]

7.3 Number of Samples Required

Producing surface water systems serving fewer than 500 people and ground water systems serving fewer than 10,000 people must collect samples **every 6 months over a 1-year period** (this sampling requirement is in addition to Stage 1 DBPR monitoring). Samples must be collected at two sites per plant and analyzed for total trihalomethane (TTHM) and five haloacetic acids (HAA5). All of a system's IDSE SMP samples must be dual sample sets, meaning one TTHM and one HAA5 sample that is taken at the same time and location. For systems with one plant, a total of 4 dual sample sets are required, and each should be analyzed for TTHM and HAA5 (see the illustration below).



Section 1.1.4 provides guidelines for estimating the number or plants in a system.

*****Examples for Determining Number of Plants, Sites, and Samples*****

Example 7.1

A system serves 450 people, purchases treated surface water through one entry point, and has two wells. Chlorine is added at each well site. The State determined that the two wells draw from the same aquifer.

Total plants: 2 (one for the purchased water entry point and one for the two wells drawing from the same aquifer)
Total sites: 2 sites per plant × 2 plants = 4 sites
Total samples: 8 samples

Example 7.2

A system serves 300 people, purchases treated surface water from one wholesaler through two entry points. The State allowed the multiple consecutive entry points to be considered as one plant.

Total plants: 1 (one plant for both consecutive entry points)
Total SMP sites: 2 sites per plant × 1 plant = 2 sites

7.4 Sample Site Requirements

Systems must select two SMP sample sites per plant, meeting the following criteria:

- One site representative of the highest TTHM concentration in the system
- One site representative of the highest HAA5 concentration in the system
- Sites must be different than the Stage 1 DBPR monitoring sites

> Stage 1 DBPR compliance monitoring sites **cannot** be used as SMP sites.

In many small systems, the highest HAA5 concentration would be expected to occur at the same site as the highest TTHM concentration. However, in some systems (often those with low disinfectant residual levels and high maximum water age) the HAA5 concentration can decrease in some parts of the distribution system, because HAA5 can biodegrade when no residual disinfectant is present. The highest HAA5 site will not be the same as the highest TTHM site. As a result, this situation is described and help is provided. Chapter 8 provides guidance for selecting SMP sites to meet the requirements of the IDSE.

7.5 Timing of Sample Collection

One of the system's sampling dates must occur in the month with the highest water temperature in their distribution system (systems should already be taking the Stage 1 DBPR compliance samples during this month). The system's other sampling date must be 6 months before or after the high distribution system water temperature month. The 6-month interval should be maintained as closely as possible (40 CFR 141.602(a)).

SMP samples should be collected as scheduled. EPA recognizes extenuating circumstances can occur that may delay sampling (e.g., an ice storm). Any deviations from the scheduled sampling days must be noted in the IDSE report (40 CFR 141.604(a)).

This regimen is expected to typically result in one sample date occurring in the summer (July through September), and the second in the winter (January-March).

7.6 Sampling Protocol

Generally, it is best to collect samples in the morning to allow the samples to be packed and shipped the same day if systems are sending them to a contract laboratory. Samples should be collected in a manner that ensures they are representative of the water in the distribution system at that sampling point. If sampling from indoor plumbing, samples should be collected from the cold water line. The line between the sample tap or faucet and the distribution system should be flushed. This can usually be accomplished by opening the faucet where the sample is collected and allowing the water to run for a few minutes. When the water temperature stabilizes, this indicates fresh water from the distribution system is being obtained.

The sample bottles should contain appropriate dechlorinating agents/preservatives prior to filling. Sampling and storage protocols outlined in the approved analytical methods must be followed. Contact the laboratory analyzing the samples for their recommended sampling and preservation protocols. Appendix C provides more detailed information on sampling procedures and approved sampling methods. Samples must be analyzed by laboratories that have received certification by EPA or the State.

If a sample is lost or broken, take a replacement sample as soon as possible. Systems only need to resample for the lost sample bottle; they do not need to resample the entire set. For example, if a TTHM sample is broken during shipping, the system would resample only for TTHM as soon as possible at the given site. Make sure to note the deviation in sampling schedule for this sample in the IDSE report.

Sampling near Fire Hydrants

Fire hydrants or blow-offs in locations that could impact the water reaching a sampling point should not be flushed prior to the collection of the disinfection byproduct (DBP) samples, because that could significantly change the "age" of the water being sampled. The intent of the DBP sampling effort is to obtain water that is representative of what the customers normally receive.

Guidance Manual Navigation

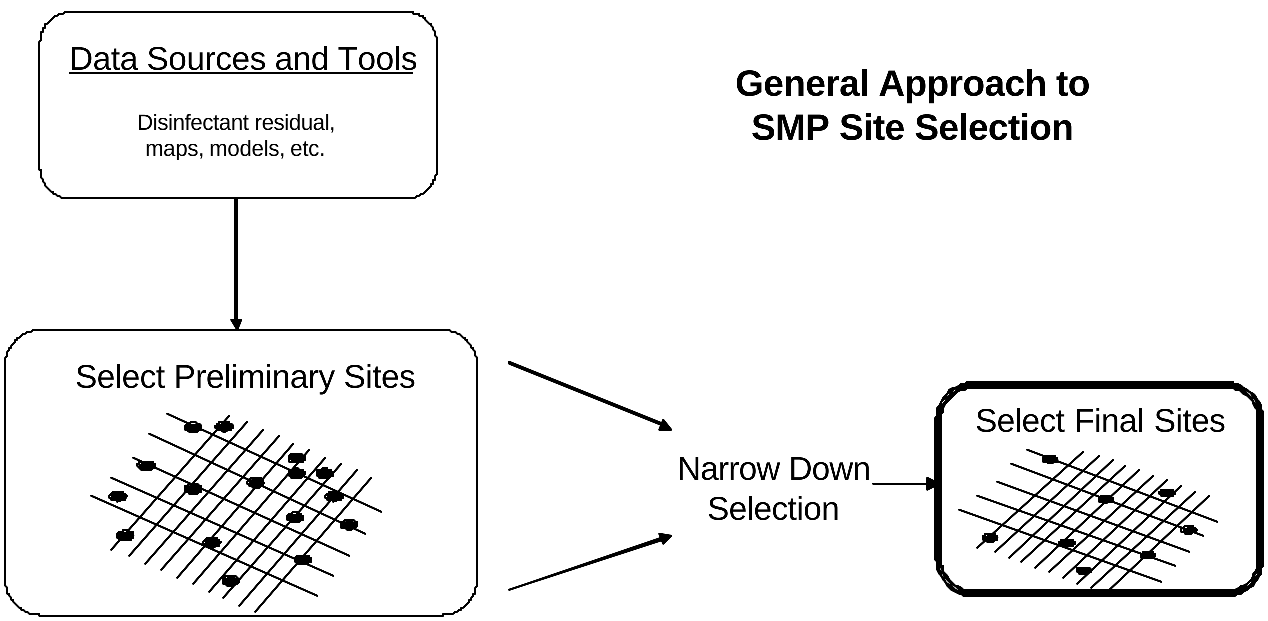
Continue to Chapter 8—*SMP Site Selection*

8.0 Standard Monitoring Program Site Selection and Reporting

8.1 Introduction

Chapters 4 through 7 of this manual provided detailed requirements for conducting an Initial Distribution System Evaluation (IDSE) Standard Monitoring Program (SMP). This chapter, which applies to *all* system types, system sizes, and source water types, expands on those chapters by providing technical guidance for selecting SMP monitoring sites using various tools.

The general approach for selecting SMP sites is to use available data sources and analysis tools to select a large number of potential sites (referred to as preliminary sites). From that group of sites, systems should consider geographic coverage and other distribution system factors to narrow down preliminary sites to final SMP sites.



This chapter is organized as follows:

Background Information

8.2 Description of SMP Site Types
8.3 Considerations for Systems with More than One Plant or Entry Point
8.4 Data Sources and Tools for Identifying Preliminary SMP Sites

SMP Site Selection

8.5 Methodology for Selecting Final SMP Sites

Stage 2B Site Selection Based on SMP Results and Reporting

8.6 Stage 2B DBPR Site Selection and IDSE Reporting Requirements

8.7 Reporting Results to the State

8.2 Description of SMP Sample Site Types

Tables 8.1 and 8.2 summarize the SMP sample site requirements according to system type, system size, and source water type (Chapter 1 also provides this information). As shown in the tables, there are four types of sampling locations defined for the SMP: near-entry point, average residence time, high total trihalomethane (TTHM), and high five haloacetic acids (HAA5). Sections 8.2.1 through 8.2.3 provide descriptions of each type of sample site. Note that all sample site types are not required for all systems and, as stated in Chapters 4 through 7, the Stage 1 DBPR compliance monitoring sites *cannot* be used as SMP sites.

Table 8.1 SMP Sampling Requirements for 100 Percent Purchasing Systems[1,2]

System Size (Population Served[3])	Number of Distribution System Sites (by location type) per System				Total Number of Sites per System	Monitoring Frequency for the 1-year IDSE Period[5]
	Near Entry Point[4]	Average Residence Time	High TTHM	High HAA5		
Surface Water Systems[6]						
< 500	-	-	1	1	**2**	Every 180 days
500 - 4,999	-	-	1	1	**2**	Every 90 days
5,000 - 9,999	-	1	2	1	**4**	Every 90 days
10,000 - 24,999	1	2	3	2	**8**	Every 60 days
25,000 - 49,999	2	3	4	3	**12**	Every 60 days
50,000 - 99,999	3	4	5	4	**16**	Every 60 days
100,000 - 499,999	4	6	8	6	**24**	Every 60 days
500,000 - < 1.5 million	6	8	10	8	**32**	Every 60 days
1.5 million - < 5 million	8	10	12	10	**40**	Every 60 days
≥ 5 million	10	12	14	12	**48**	Every 60 days
Ground Water Systems						
< 500	-	-	1	1	**2**	Every 180 days
500 - 9,999	-	-	1	1	**2**	Every 90 days
10,000 - 99,999	1	1	2	2	**6**	Every 90 days
100,000 - 499,999	1	1	3	3	**8**	Every 90 days
≥ 500,000	2	2	4	4	**12**	Every 90 days

1 (40 CFR 141.602 (b))

2 For the purposes of this manual, *100 percent purchasing systems* are those systems that buy or otherwise receive all of their finished water from one or more wholesale systems year-round.

3 *Population served* is usually a system's retail population. It should not include populations served by consecutive systems that purchase water from that system.

4 See section 8.2 for requirements when the number of entry points in a system is different from the number of required near-entry point sites in this table.

5 Monitoring frequency is the approximate number of days between monitoring events. A dual sample set must be collected at each location.

6 For the purpose of this guidance manual, "surface water systems" are equivalent to subpart H systems (i.e., any system that uses surface water or GWUDI as a source, including all mixed systems that use some surface water or GWUDI and some ground water).

Table 8.2 SMP Sampling Requirements for Producing Systems[1,2]

System Size (Population Served[3])	Residual Disinfectant	Number of Distribution System Sites (by location type) for each Plant: Near-Entry Point	Average Residence Time	High TTHM	High HAA5	Total Number of Sites per Plant	Monitoring Frequency[4]
Surface Water Systems[5]							
< 500	Chlorine or Chloramines	-	-	1	1	**2**	Every 180 days
500 - 9,999	Chlorine or Chloramines	-	-	1	1	**2**	Every 90 days
≥ 10,000	Chlorine	1	2	3	2	**8**	Every 60 days
	Chloramines	2	2	2	2	**8**	
Ground Water Systems							
< 10,000	Chlorine or Chloramines	-	-	1	1	**2**	Every 180 days
≥ 10,000	Chlorine or Chloramines	-	-	1	1	**2**	Every 90 days

1 (40 CFR 141.602(a))
2 For the purpose of this guidance manual, *producing systems* are those that do not buy 100 percent of their water year-round (i.e., they produce some or all of their own finished water).
3 *Population served* is usually a system's retail population. It should not include populations served by consecutive systems that purchase water from that system.
4 Monitoring frequency is the approximate number of days between monitoring events. A dual sample set must be collected at each location. A dual sample set is one TTHM and one HAA5 sample that is taken at the same time and location.
5 For the purpose of this guidance manual, "surface water systems" are equivalent to subpart H systems (i.e., any system that uses surface water or GWUDI as a source, including all mixed systems that use some surface water or GWUDI and some ground water).

As described in previous chapters, the monitoring requirements for producing systems are based on the number of plants. The Stage 2 DBPR does not define a plant, but does specify the following:

- Consecutive system entry points receiving disinfected water for at least 60 *consecutive* days must be considered a plant (40 CFR 141.602(a))

- Multiple entry points or multiple wells drawing from the same aquifer may be considered as one plant (40 CFR 141.601(d))

For guidance purposes, any location where disinfected water enters the distribution system should be considered a "plant". See Chapter 1, section 1.1 for guidance on determining number of plants in a system.

8.2.1 Near-Entry Point SMP Sites

The rule does not have specific location requirements for near entry point sites. EPA recommends locating these sites between the treatment facility or consecutive system entry point and before or near the first customer. Data from this site represent the minimum residence time and can be used as a baseline for interpreting changes in water quality as water travels through the distribution system. DBP data from near-entry point sites can also be used to identify opportunities for improvements at the treatment plant.

The next two sections provide additional guidance for selecting near-entry point SMP sites.

8.2.1.1 Near-Entry Point SMP Sites for 100 Percent Purchasing Systems

As indicated in Table 8.1, the number of near-entry point sites required for 100 percent purchasing systems depends only on the source water type and population served. As a result, a situation may exist where a system has more or less actual consecutive system entry points than the number of near-entry points sites required by Table 8.1 or Table 8.2. If this occurs, the rule requires the following adjustments (40 CFR 141.6022(b)):

- If the required number of near-entry point SMP sites is *less than* the actual number of consecutive system entry points, first select sites at the entry points delivering surface water in order from the highest to lowest flow, then select sites at the entry points delivering ground water, in order from the highest to lowest flow, until the required number of SMP sites have been identified. (See Example 8.1.)

Example 8.1 Less Required than Entry Points in the Systems

A 100 percent purchasing system receives ground water from two wholesalers and serves 300,000 people. Approximately 70 percent of the system's water is purchased from Wholesaler A, the remaining 30 percent from Wholesaler B. The IDSE SMP requirements for this system include one near-entry point site (see Table 8.1). This system should locate its near-entry point site near the Wholesaler A consecutive system entry point.

- If the required number of near-entry point SMP sites is *more than* the actual number of consecutive system entry points, the "excess" near-entry point sites must be distributed among high TTHM and high HAA5 sites so that the total number of SMP sites is met. These excess sites must be distributed in the order of high TTHM, high HAA5 . (see Example 8.2.)

Example 8.2 Excess Near-entry Point Site Requirements

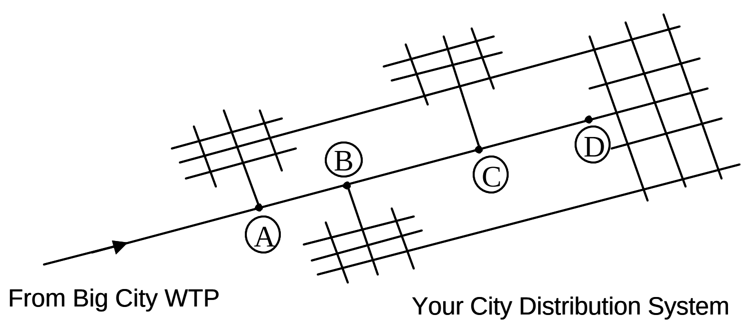
A 100 percent purchasing system receives surface water from three wholesalers and serves 550,000 people. The IDSE SMP requirements for this system include six near-entry point sites (see Table 8.1), but the system has only 3 consecutive system entry points. This system must select 3 near-entry point sites. According to the rule stated above, the remaining 3 near-entry point sites would be distributed as follows: 2 high TTHM sites and 1 high HAA5 site.

Multiple Entry Points Considered as One Plant

Multiple consecutive entry points may be considered a single plant with approval from the State (40 CFR 141.601(d)). There is no provision in the rule designating which entry point must be used to locate the near-entry point site. A location near any entry point or prior to the first group of customers for any one entry point should be acceptable. However, if the average flow differs significantly between the entry points, you should consider using the entry point with the greatest flow to locate your near-entry point SMP site. (See Examples 8.3 and 8.4.)

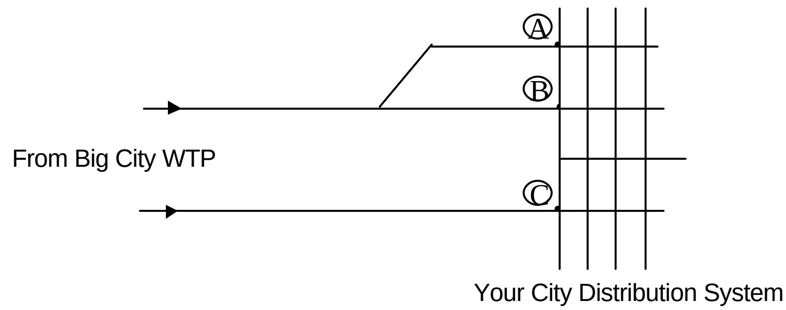
Example 8.3 Multiple Entry Points on One Transmission Line

Your City receives water from Big City through a single transmission main with multiple consecutive system entry points (A, B, C, and D) and little difference in average flows. The State has determined these entry points are a single source and the estimated water age at each entry point is similar. In this case, A, B, C, or D would be acceptable and should be



Example 8.4 Multiple Entry Points with Different Flows

Your City receives water from Big City at three consecutive system entry points (A, B and C). Entry points A and B are branches of a common main; entry point C is off a separate main. The State has determined these entry points are a single source and the estimated water age at each entry point is similar. 50 percent of Your City's water enters through A, 20 percent through B, and 30 percent through C. Your city selects a near-entry point SMP site near A because the majority of water enters through this entry point.



8.2.1.2 Near-Entry Point SMP Sites for Producing Systems

The rule requires producing *surface water systems* that *serve at least 10,000 people* to select near-entry point sites depending on the total number of plants in the system and the residual disinfectant type (40 CFR 141.602 (a)) (see Table 8.2).

- Chlorinated systems must select <u>one</u> near-entry point SMP site <u>per plant</u>
- Chloraminated systems must select <u>two</u> near-entry point SMP sites <u>per plant</u>

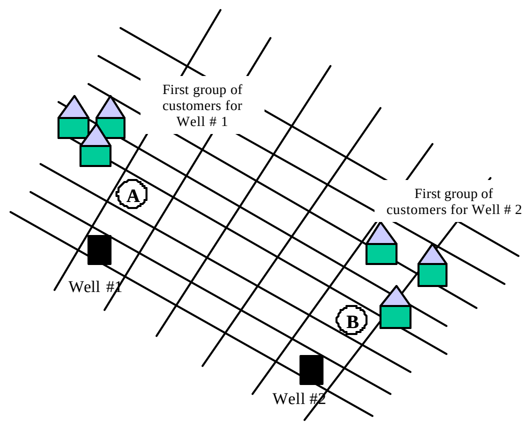
The requirements differ between chlorinated systems and chloraminated systems because DBP formation differs under chloraminated and chlorinated conditions. Chloramine residuals are more stable than chlorine residuals and, therefore, do not react as readily with organic compounds in the water. Based on evaluation of Information Collection Rule (ICR) data, DBP concentrations in chloraminated systems vary less throughout the distribution system than in chlorinated systems. HAA5, in particular, can peak at or near the entry point to the distribution system in a chloraminated system. (Appendix B describes DBP formation in more detail.) As recommended in the beginning of section 8.2.1, any sites between the treatment facility (or entry point) and a first group of customers should be acceptable for chloraminated systems.

Ground Water Wells or Multiple Entry Points Considered as One Plant

Multiple ground water wells drawing from one aquifer and delivering disinfected water directly to the distribution system may be considered a single plant with approval from the State. Locations prior to the first group of customers of any well are an acceptable near-entry point SMP site. Similarly, for multiple consecutive entry points considered as a single plant, any entry point would be acceptable for a near-entry point SMP site. (See Example 8.5.)

Example 8.5 Multiple Entry Points

The system has two wells which the State determined were drawing from the same aquifer and could be considered as one plant. Site A or Site B would be acceptable for their near-entry point site.



8.2.2 Average Residence Time SMP Sites

Sites with average residence time should represent the average water age that is delivered to the majority of customers in the distribution system. In most distribution systems, average residence time is <u>not</u> simply one-half the maximum residence time. Ideally, it should be a flow-weighted or population-weighted average residence time. EPA recognizes that determining this value is very complex and, at best, most systems can only make a rough estimate. Section 8.4 provides methodologies for estimating average residence time with various types of data and tools.

8.2.3 High TTHM and High HAA5 Sites

It is not the intent of the SMP to identify peak daily or hourly DBP concentrations. Instead, high TTHM and high HAA5 sites should be chosen to represent areas in the distribution system with the highest annual average DBP concentrations. Higher temperatures and increased residence time typically lead to higher TTHM and HAA5 concentrations. However, HAA5 can biodegrade when disinfectant residual levels are low or non-existent and, therefore, a high HAA5 site may not be the site with the longest residence time. These principles are the basis of the guidance provided for selecting high TTHM and high HAA5 SMP sites. Table 8.3 summarizes the typical characteristics of distribution system areas with high TTHM and high HAA5 levels. Section 8.4 further describes how data sources and analysis tools can be used to identify these areas in the distribution system.

Table 8.3 Summary of Characteristics of High TTHM and High HAA5 Areas

Area	Characteristics
High TTHM	S Long residence time (e.g. remote areas with few customers or low water demand) S Low or no disinfectant residual, also high heterotrophic plant count (HPC) or history of positive coliform S Downstream of storage facilities S Areas with historical data showing high TTHM
High HAA5	S Residence time can vary S Low but existing disinfectant residual (to prevent biodegradation) S May be downstream of storage facilities S Areas with historical data showing high HAA5

Note: These are only general characteristics; DBP formation in distribution systems is system-specific.

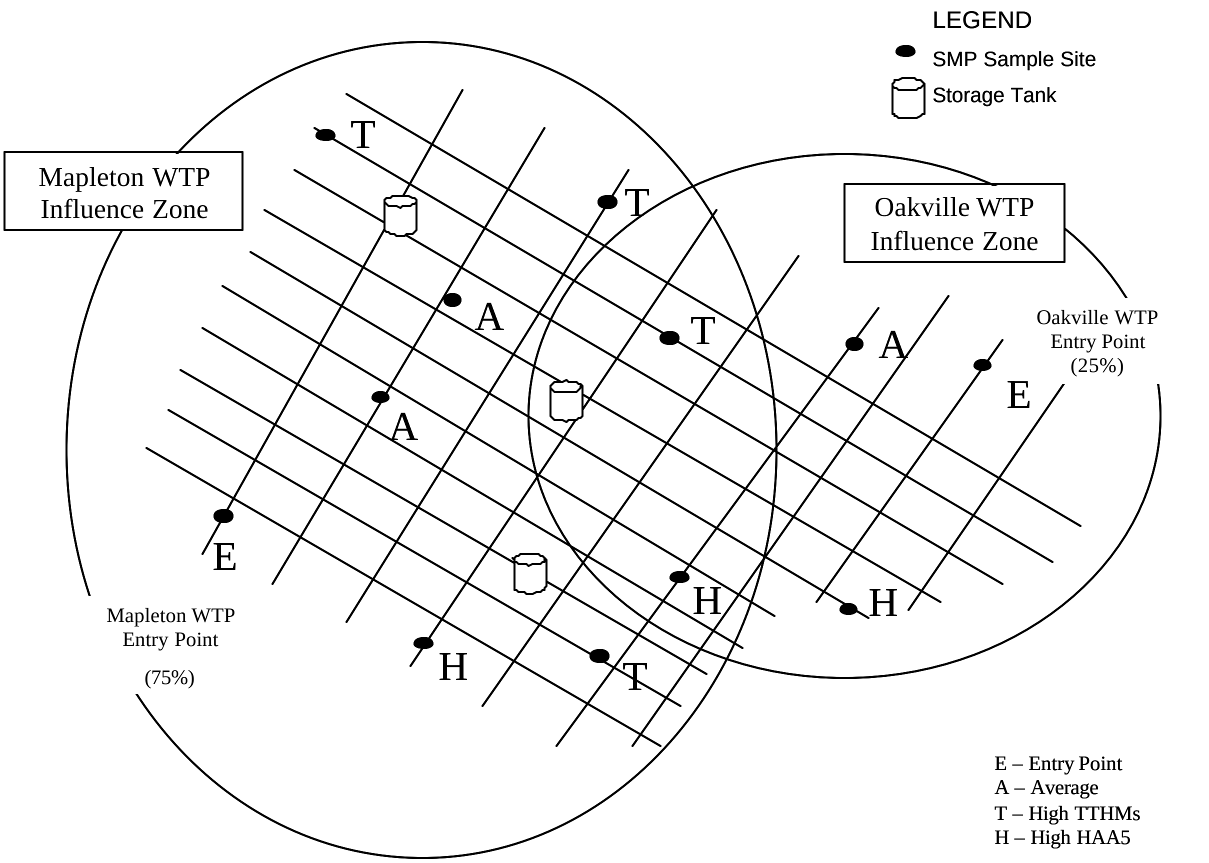
8.3 Considerations for Systems with More than One Plant or Entry Point

This section describes how systems with multiple plants or entry points should distribute the sites with respect to the influence zone of each plant or entry point.

8.3.1 100 Percent Purchasing Systems with More Than One Consecutive System Entry Point

The 100 percent purchasing systems <u>are not</u> required to assign SMP sample sites to the influence zone of a particular entry point. When selecting average residence time and high TTHM/high HAA5 SMP sites, 100 percent purchasing systems should consider the quantity and quality of water received at each consecutive system entry point. For example, if one entry point supplies 75 percent of the water then more SMP sites should be located in the influence zone of that supply. Geographic distribution of SMP locations should also be considered. Examples 8.6 and 8.7 illustrate how sites could be distributed with respect to multiple entry points.

Example 8.6 Large and Small Surface Water Entry Points



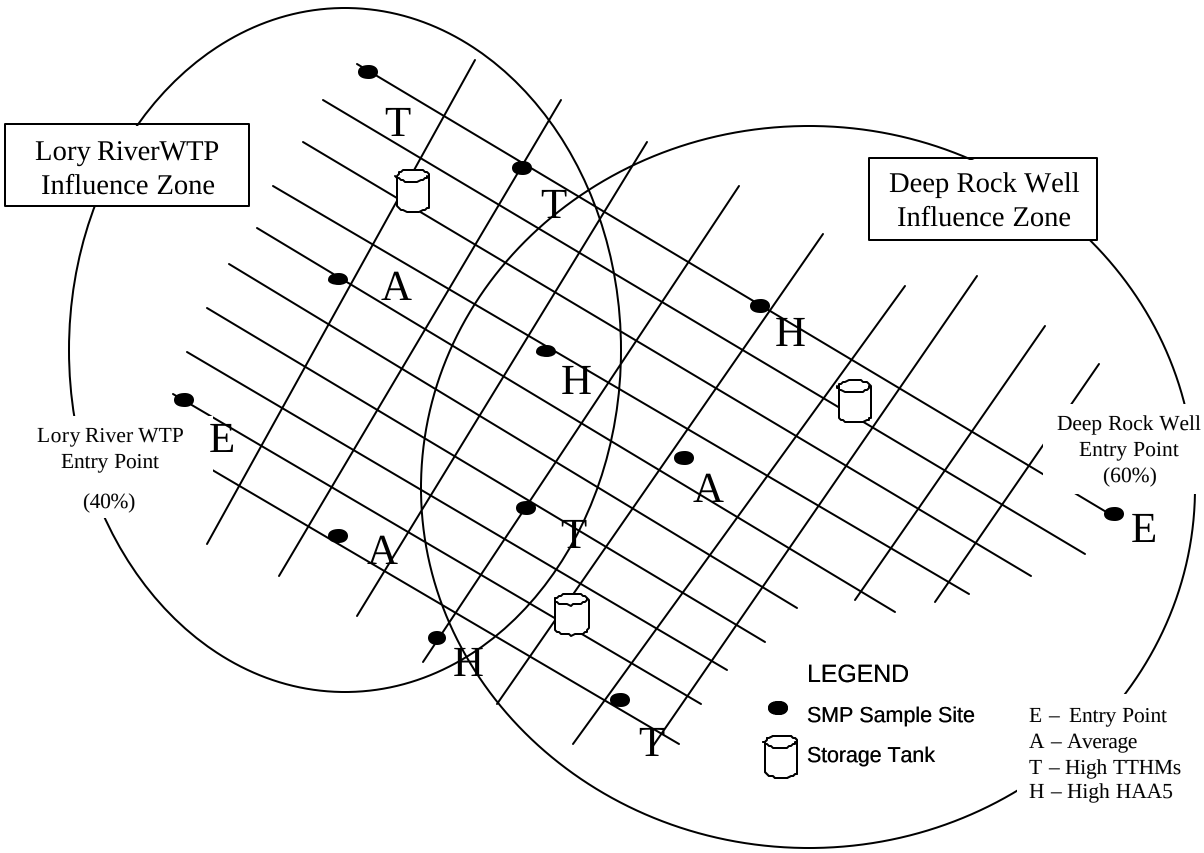
Your City is a 100 percent purchasing system serving 30,000 people and purchases chlorinated water from two surface water wholesalers (Mapleton and Oakville). Your City is required to identify 12 SMP sites (from Table 8.1—2 near-entry points, 3 average, 4 high TTHM, and 3 high HAA5 sites). On average, Mapleton supplies Your City with 75 percent of its water; while Oakville provides only 25 percent. The water quality from each is similar.

Site selection rationale:

Based on the average flow split and similar water quality, approximately 75 percent (9) of the sites should be in the influence zone of the Mapleton supply and the remaining 25 percent (3) should be in the influence zone of the Oakville source. As shown in the schematic, in order to achieve a good geographic coverage of the distribution system, 2 of the Mapleton sites are located in

Example 8.7 Surface Water and Ground Water Entry Points

Your City is a 100 percent purchasing system serving 48,000 people with purchased water from two water wholesalers. The Lory River WTP supplies 40 percent of the demand with surface water. The Deep Rock well supplies 60 percent of the demand with ground water. Your City is required to identify 12 SMP sites as follows: 2 near-entry point, 3 average residence time, 4 high TTHM, and 3 high HAA5.



<u>SMP selection rational</u>:

More sites are placed within the influence area of the Lory River WTP because it is a surface water source and thus, more likely to have higher DBP levels.

8.3.2 Producing Systems with More than One Plant

As indicated in Table 8.2, the rule specifies the number of SMP sites *for each plant*. For most systems, the distribution areas of the plants are not distinctly separate. However, systems can usually identify the primary influence zones of each plant and should use these zones to assign SMP sites. Recognizing that the boundaries of influence zones can overlap and change on a daily, hourly, and seasonal basis, SMP sites should be chosen within the typical (during normal operating mode) influence zone boundaries, as best can be determined.

Once sample sites have been selected based on the typical influence zone boundaries, the *samples must be collected as scheduled*, regardless of the actual source of water serving the site at the time of sampling (40 CFR 141.602(c)). If it is suspected or known that the source of water supplying a particular SMP site is different during sample collection, then this should be noted and taken into consideration when evaluating the results of the SMP. However, identification of the source of supply to each sample site during each sampling event is <u>not</u> required.

Where overlap exists between two or more influence zones, the water quality, quantity, and operating characteristics should be considered when locating SMP sites. There are numerous scenarios that could exist when a distribution system is supplied with water from more than one plant. The following sections provide general guidance and examples for four specific scenarios:

- One plant produces the majority of the water (Example 8.8)
- One plant supplies water with much higher TTHM/HAA5 concentrations than the other plant(s) (Example 8.9)
- The system purchases water for less than 60 <u>consecutive</u> days per year (Example 8.10)
- The system has a seasonal source of water (used at least 60 <u>consecutive</u> days per year, but less than 100 percent of the time) (Example 8.11)

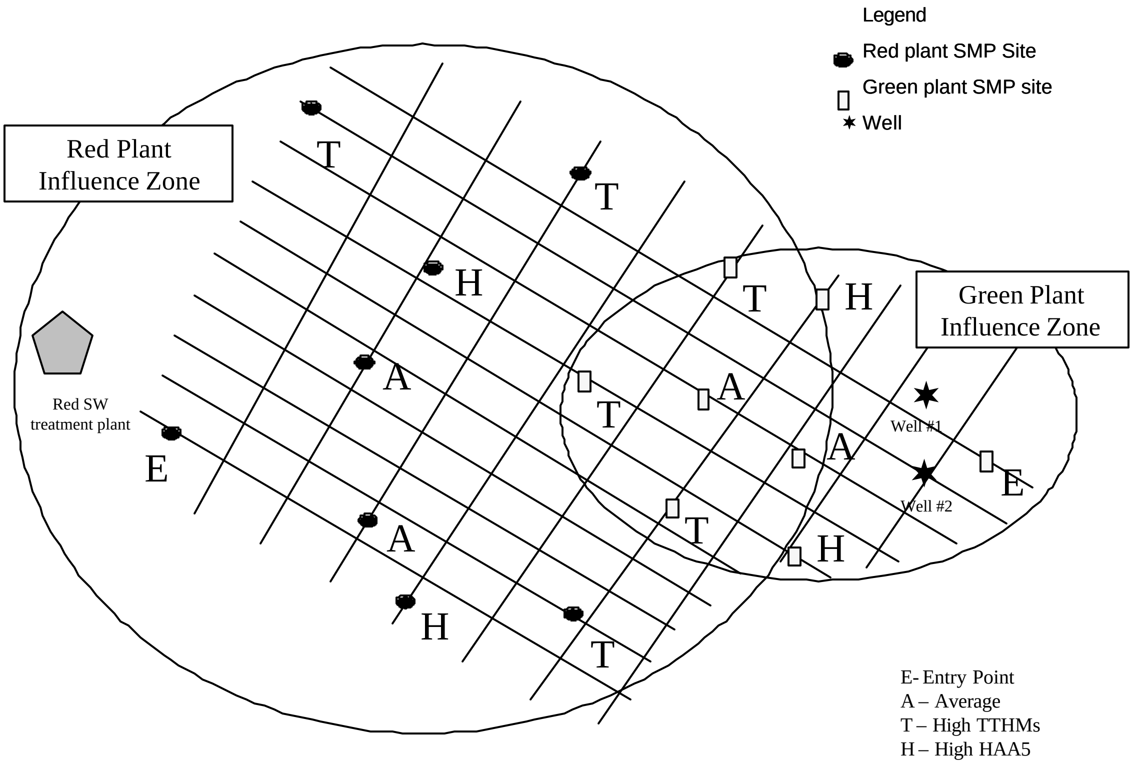
The guidelines for these four scenarios are general and will not apply to all systems and all situations; you should always use best professional judgement when selecting SMP sites.

One Plant Supplies the Majority of the Water

In systems where one plant delivers substantially more water than another, an equal distribution of sites within influence zones may result in disproportionate coverage of the distribution system. That is, the sites representing a large treatment plant must cover a wider geographic area than the sites representing a smaller plant. Example 8.8 illustrates this situation and provides an SMP selection approach that maximizes coverage of the distribution system while still locating SMP sites for each plant in the appropriate zone of influence. In the example, SMP sites required for the smaller plant are used to cover the entire area of the overlapping influence zones; SMP sites for the large plant are located exclusively in the influence zone of the large plant.

Example 8.8 Producing System with One Large and One Small Plant

A system supplying 12,000 people has 2 chlorinated plants, Red and Green. The Red plant is a surface water treatment plant that provides 8 MGD. The Green plant is supplied by 2 wells drawing from the same aquifer, produces 1 MGD, and has been approved by the State as drawing from a common aquifer. Generally, the Green plant supplies the east area of the distribution system and the Red plant supplies all other areas. From Table 8.2, a total of 8 SMP sites for each plant are required for mixed surface and ground water systems.



Site selection rationale:

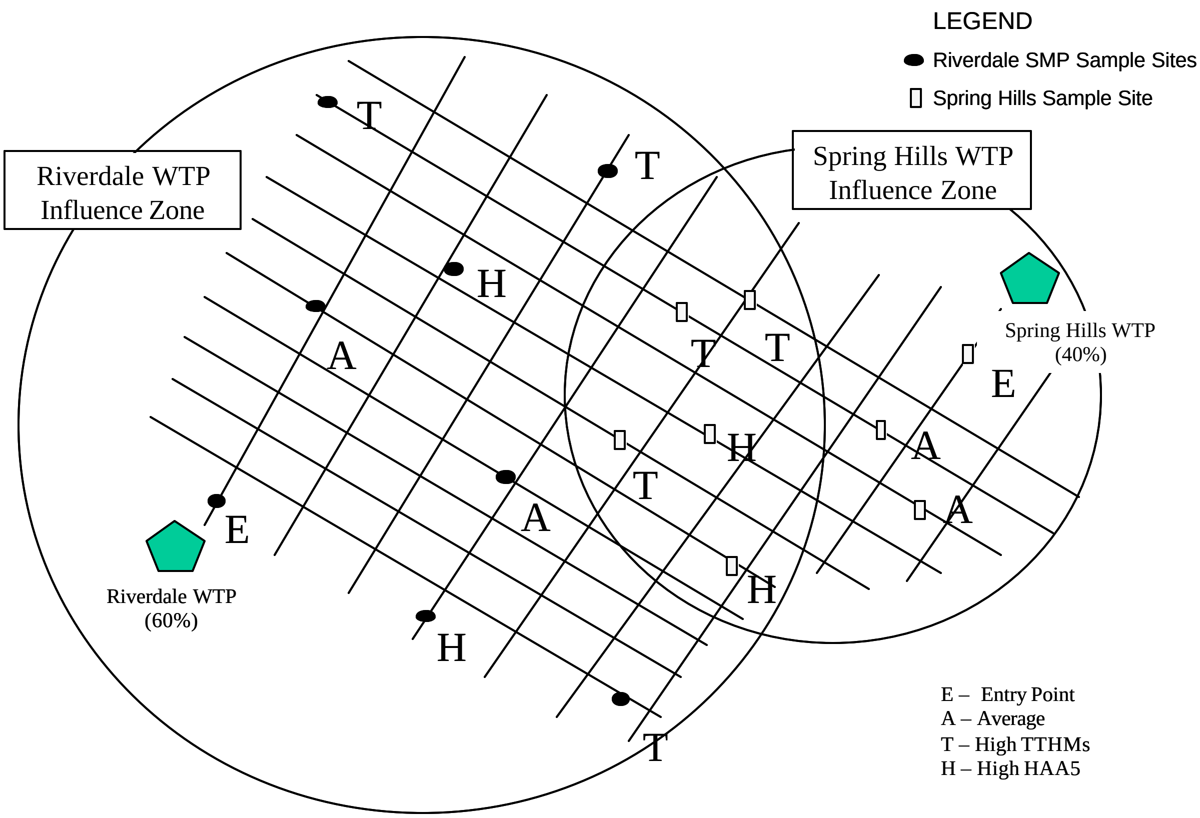
For both plants, the 8 required SMP sites are located in the influence zone of the respective plant. Because the Green plant has a much smaller influence area, Green's sites are selected to cover the overlapping mixing zone, thus allowing the 8 Red sites to cover the larger Red influence zone. This arrangement of sites respects the requirement to locate sites within individual plant influence

One Plant Supplies Water with Much Higher DBP Concentrations Than the Others

Systems should also consider quality of water when locating SMP sites. The overall objective of the IDSE SMP is to identify sites in the distribution system where water with representative high TTHM and HAA5 concentrations is delivered to customers. If you suspect that the high TTHM and/or high HAA5 sites will be in the influence zone of a particular plant on more than a seasonal basis, you should locate SMP sites to maximize coverage in that influence zone. Example 8.10 shows how SMP sites can be located when one source is suspected of having high TTHM/HAA5 concentrations.

Example 8.9 Producing System with One High- and One Low-DBP Plant

Your City is a producing system serving 85,000 people. Your City operates 2 plants—Riverdale (a surface water plant with moderate to high source water TOC levels) and Spring Hills (a low-TOC ground water plant). Riverdale provides approximately 60 percent of your daily demand and Spring Hills the remaining 40 percent. Both plants use free chlorine for primary and secondary disinfection.



From Table 8.2, Your City is required to select 8 SMP sample locations for each treatment plant (a total of 16 sites). Since the Spring Hills supply is likely to have lower DBP concentrations than the Riverdale supply, locate the Riverdale SMP sites exclusively in the Riverdale influence zone and use the Spring Hills SMP sites to cover the mixing zone.

Emergency Connections (Used Less Than 60 Consecutive Days per Year)

Consecutive entry points used on a temporary basis that provide water for less than 60 **consecutive** days per year are *not* considered to be "plants" under the IDSE SMP requirements (141.602 (d)(2)). In other words, systems do not have to identify near-entry point, average residence time, or high TTHM/HAA5 SMP sites for these entry points. However, typical water demand patterns in the area of the distribution system supplied by the temporary source (influence zone) should be considered when locating SMP sites (see Example 8.10).

Example 8.10 Producing Systems with Temporary Sources

- A large surface water system buys water during the highest temperature month(s) from a system with a low-TOC ground water source. In this case, **SMP sites should not be located in the influence zone of the temporary source**; focus should be on other areas of the distribution system. The reason for this is the influence zone of the temporary source is likely to have lower DBP concentrations than areas served by the surface water supply.

- A large surface water system buys water that is low-TOC ground water source, but *not* during the highest temperature month(s). In this case, you **should consider locating SMP sites in the influence zone of your temporary source** because the zone will be more representative of your surface water source during the highest temperature month. This is particularly applicable if you believe the area has high TTHM or high HAA5 levels when it is supplied by your normal surface water supply. You should be cognizant, however, of which source is providing the water that you are collecting during your SMP. If you collect a sample that is not representative of your surface water source, you should note this information in your IDSE report and consider that when selecting final Stage 2B DBPR compliance monitoring sites (see sections 8.6 and 8.7 for guidelines for selecting Stage 2B DBPR compliance monitoring sites and completing your IDSE report).

Purchasing Water on a Part-time Basis (Used at Least 60 Consecutive Days per Year)

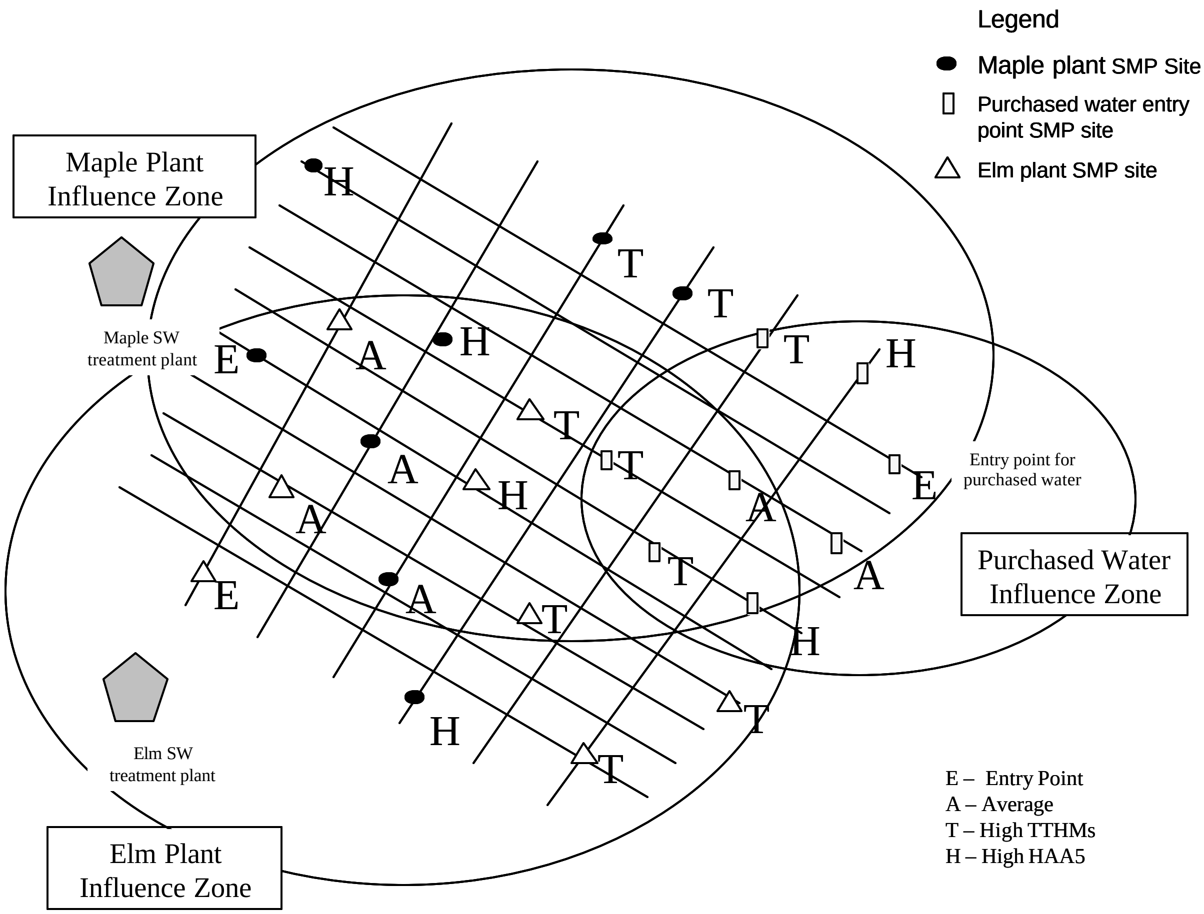
If a system buys water from a wholesale system on a part-time or seasonal basis, for more than 60 **consecutive** days of the year, the source is considered to be a "plant" under the IDSE SMP requirements (141.602 (d)(2)). As with plants operating year-round, the SMP sites for a seasonal plant should be located in the influence zone of that plant. Although the seasonal plant would not be providing water to the SMP sites all the time, the SMP sampling sites should *not* be modified once sampling has begun (SMP sites should remain fixed for the 1-year monitoring period).

Even if water from a seasonal plant is known to have low DBP concentrations relative to water provided by other plants (e.g., a seasonal ground water supply in a surface water system), the eight sites for the seasonal plant should still be selected within the influence zone of that plant. DBP data of all plants are important in evaluating the entire distribution system.

Example 8.11 illustrates the SMP site selection for a large producing system that operates two surface water plants and purchases water during the summer to meet increased seasonal demands.

Example 8.11 Producing System with Seasonal Plants

A system serving chlorinated water to 55,000 people has three plants: Maple plant (6 MGD surface water), Elm plant (3 MGD surface water), and purchased water from a neighboring city (2 MGD in summer only—for more than 60 consecutive days).



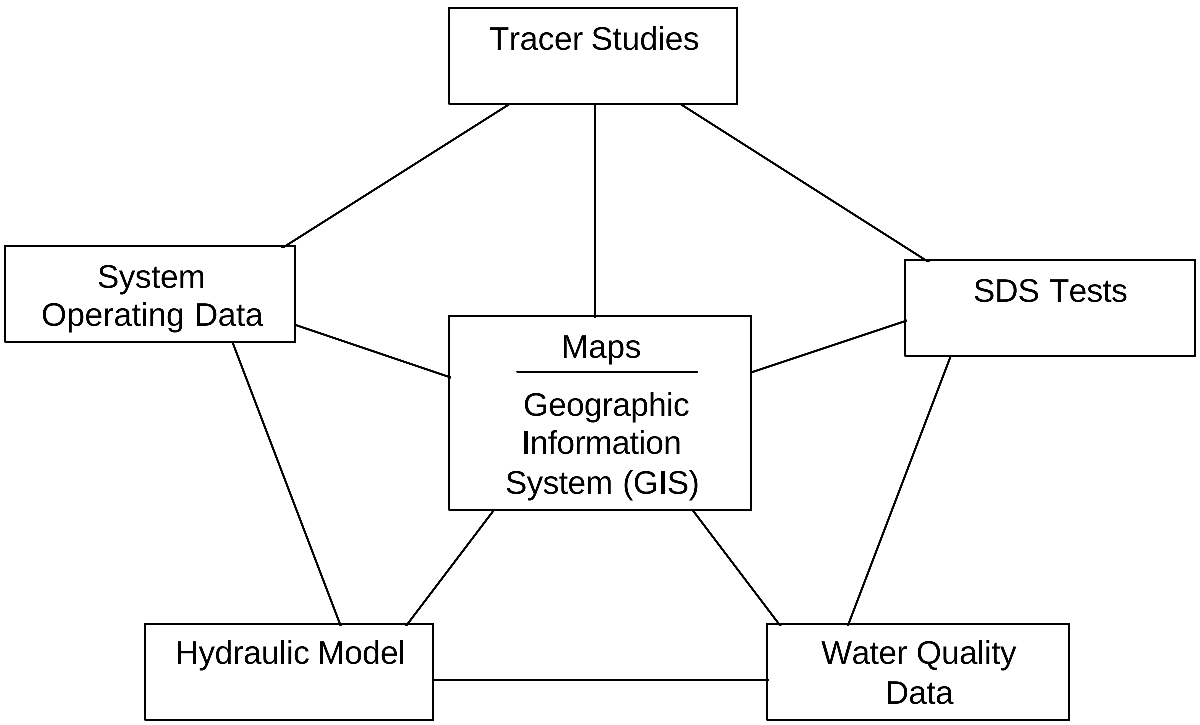
Site selection rationale:

The Maple plant and Elm plant influence zones mostly overlap; together, their sites cover the entire area except the influence zone of the purchased water. Although the system only purchases during the summer, those sites will be sampled during the entire 1-year SMP sampling period and will represent the surface water plants' water quality for a majority of the year.

8.4 Data Sources and Tools for Identifying Preliminary SMP Sites

Several sources of information can be used to help select SMP sites that represent average residence time, high TTHM, and high HAA5 concentrations (see Figure 8.1 below).

Figure 8.1 Data Sources and Tools for Selecting SMP Sites



These data sources and tools are best applied in combination with each other. For example, a map is critical in assessing geographic and population coverage; however, it is of limited use when used alone to identify average residence time or high HAA5 sites.

Generally, data used to identify SMP sites should be less than 10 years old and represent the current distribution system and treatment plant(s) configuration. Chapter 3 discusses the quality of data recommended for use in a historical data-based SSS.

This section describes how each data source can be used to identify preliminary SMP sites representing high TTHM, high HAA5, and average residence time. Section 8.5 presents step-by-step methodologies for using combinations of these data sources to select final SMP sites.

8.4.1 Maps

Map features that may be helpful in selecting SMP sites include:

- Length and diameter of pipes
- Age of pipes
- Pressure zone delineations with valving identified
- Location of distribution system pumping stations
- Location and configuration of storage facilities
- Location of fire hydrants and flush valves
- Existing land use
- Population density
- Location of booster disinfection stations
- Entry points with source type noted
- System boundary lines

8.4.1.1 High TTHM and High HAA5 Sites

Generally, areas with light development, with low residential population density, or between pressure zones that are furthest away from the treatment plant(s) are likely to have the longest residence times. Therefore, these areas have potentially high TTHM concentrations and, provided there is a detectable disinfectant residual, high HAA5 concentrations.

In general, sites at the *very* end of a distribution system main with no customers should not be selected:

- In many distribution systems, there may be no customers at the actual physical end of some dead-end sections of a water main. Water quality at this type of location is not truly "representative" of water in the distribution system that is delivered to customers.

High TTHM (and in some cases HAA5) SMP sites should be generally located **near the ends of the distribution system at or before the last group of customers or in mixing zones**.

Sample sites should be located **prior** to the last fire hydrant.

Sample sites **should not be located at a dead-end** where there are no customers.

- High TTHM and, in some cases, high HAA5 SMP sites should generally be chosen near the end of the distribution system at the last group of customers or in mixing zones where “hydraulic dead-ends” might occur. Samples should always be collected at locations prior to (upstream of) the last fire hydrant.

Storage facilities in a distribution system increase water age. During tank drain cycles, water age immediately downstream of a storage facility may be significantly (e.g., several days or more) older than “fresh” water upstream of the storage facility. As a result, areas of a distribution system receiving water that has been stored may have higher TTHM and HAA5 concentrations than areas that do not receive any stored water. Therefore, you should generally locate your high TTHM sites and, in some cases, high HAA5 sites downstream of storage facilities.

8.4.1.2 Average Residence Time Sites

Average residence time is the average age of water delivered to the majority of customers in a distribution system. Estimating average distribution system residence time based solely on maps can be difficult and requires a thorough understanding of your distribution system. Under ideal circumstances, maps are just one tool that can be combined with other data and tools (e.g., disinfectant residual data, hydraulic modeling) to identify areas that are representative of average water age. These other data and tools are discussed further in sections 8.4.2 through 8.4.7.

Approximate average residence time areas can be identified by looking for service areas with the most development. If a few large customers exist in a system, then their location should be identified and the effect of water flowing to them taken into consideration. In many systems that do not have large individual customers, highly developed areas in the approximate geographic center of the distribution system are potential average residence time sites.

8.4.2 Distribution System Water Quality Data

Systems routinely sample for various water quality parameters as required by regulations or for operational purposes. A review of recent historical DBP and/or disinfectant residual data (free chlorine or chloramine) can be very useful in the selection of SMP sample sites.

8.4.2.1 Disinfectant Residual Data

Because chlorine and chloramines decay over time, low disinfectant residuals relative to those leaving the treatment facility (or entering through a consecutive system entry point) can generally be considered an indicator of increased water age. A review of disinfectant residual data from existing distribution system monitoring sites can help identify the areas of your system with the highest residence time and those with average residence time. Sources of disinfectant residual data may include regular compliance monitoring sites (e.g., Total Coliform Rule (TCR) or Stage 1 DBPR monitoring sites), operational sample sites, or special sites sampled in response to customer complaints. Combining the data from these various sample sites may help you better understand the change in disinfectant residual as water flows through your distribution system and, consequently, help you choose the required SMP sample sites.

> Sources of disinfectant residual data:
> - TCR data
> - Stage 1 DBPR data (for some systems)
> - Operational sample sites
> - Sampling in response to customer complaints

There are cases, however, where lower disinfectant residuals do not necessarily indicate greater water age. Common factors that can influence disinfectant residual decay and affect the relationship between residual levels and water age are:

- Pipe material and internal lining
- Corrosion condition in the pipe
- Biofilm growth in the pipe
- Accumulation of sediment in the pipe
- Booster disinfection

In particular, use of disinfectant residual data becomes difficult when booster disinfection is applied. Booster disinfection is the practice of adding a disinfectant in the distribution system to raise the disinfectant residual concentration and is commonly used in peripheral zones of the distribution system or near storage tanks where water age may be high and disinfectant residuals are low. TTHM and HAA5 levels are likely to increase after a booster disinfectant is applied. Additional TTHM and HAA5 may be formed due to the greater concentration of disinfectant available for reaction with DBPs precursors. Furthermore, the additional disinfectant prevents the biological degradation of HAA5, thus favoring their accumulation in the areas of the distribution system affected by booster chlorination.

If your system does not have much disinfectant residual data, or if you are not able to identify sites with average or high residence times based on your existing data, you may want to collect additional disinfectant residual data from your system to better characterize your system and provide a better basis for selecting SMP sample sites.

1) High TTHM and High HAA5 Sites

Booster Disinfection

If your system uses booster disinfection continuously or intermittently, the high TTHM and HAA5 sites should not be located before a booster disinfection station.

Low Disinfectant Residual Relative to System Average

Low disinfectant residuals relative to the system average generally indicate longer residence times, and may correlate with higher TTHM and HAA5 concentrations. Very low or no disinfectant residual, however, could also indicate biological decay of HAA5, and should generally not be chosen as your high HAA5 site.

- When selecting preliminary high HAA5 sites, locations with free chlorine residuals less than 0.2 mg/L or chloramine residuals less than 0.5 mg/L should not be selected because of the potential for biodegradation of HAA5.

- High HAA5 sites should have no significant increase in recorded HPCs to ensure a low potential for HAA5 biodegradation. If you have HPC data, a comparison of disinfectant residual and HPC data can help you more precisely determine the threshold disinfectant residual below which HPC levels begin to increase. However, HPC testing is not required as a part of the IDSE.

Review Disinfectant Residual Data from the Warmer Months

Because disinfectant residuals typically decay faster during the summer, a review of data from the summer months may be more useful in identifying areas with consistently low residuals. During the winter, disinfectants are usually more persistent, and residuals can often be maintained in relatively old water within a distribution system. The correlation between residence time and residual decay is less pronounced in the colder months.

2) Average Residence Time Sites

One of the best ways to calculate average residence time is by using a hydraulic model (see Chapter 3 for information on hydraulic modeling). However, if this tool is not available, calculating the average disinfectant residual in your distribution system can help you identify locations with average water residence time (this method is not valid for areas in the influence of booster disinfection). When calculating average disinfectant residual, it is important that you use data from sites that are representative of your entire distribution system. One way to do this is to limit data to those collected at your TCR monitoring sites (the TCR requires that all monitoring sites combined represent the distribution system). Use of historical data or other data (e.g., data from customer complaints) could skew the results if a large portion of the data are from a single area.

Assuming your disinfectant residual data are representative of your distribution system, the following analysis of TCR monitoring data can be used to help identify sites with average residence time:

1) Calculate an average disinfectant residual at each of your TCR sites using data from your warmest months (chlorine decay is more pronounced in warmer temperatures so you are more likely to see larger changes in chlorine residual from one point to the next).

2) Using averages from the individual sites, calculate an overall distribution system average residual concentration.

3) Those sites with an average residual close to the distribution system average can be considered representative of average residence time in the distribution system.

Note, if your system has booster disinfection, then residual data collected after those locations will skew this analysis. You should either omit that data or estimate what the residual would be without the added disinfectant.

Example 8.12 System Average Disinfectant Residual Calculation

A system with June, July, and August as their warmest months has the residual data below. The averages for the system and each site are calculated as shown. Note that sites #2, #3, and #9 have average chlorine residual concentrations close to the system average.

Site ID	Monthly Average (mg/L)			Site Average (mg/L)
	Jun	Jul	Aug	
#1	1.4	1.3	1.6	1.4
#2	***0.7***	***0.9***	***0.7***	***0.8***
#3	***1.0***	***0.9***	***1.2***	***1.0***
#4	0.6	0.6	0.7	0.6
#5	0.9	1.2	1.4	1.2
#6	0.4	0.5	0.4	0.4
#7	0.2	0.3	0.6	0.4
#8	1.5	1.7	1.7	1.6
#9	***0.9***	***0.7***	***0.8***	***0.8***
#10	0.5	0.3	0.8	0.5
Distribution System Ave	**0.8**	**0.8**	**1.0**	**0.9**

8.4.2.2 DBP Data

Non-compliance DBP (TTHM and HAA5) data, collected in addition to your Stage 1 DBPR compliance monitoring data, can be useful in selecting high TTHM and high HAA5 SMP sites. Remember, however, that Stage 1 DBPR compliance monitoring sites *cannot* be used as SMP sites (141.602(b)). For surface water systems, historical DBP data should be evaluated with respect to raw water quality conditions before and during the sampling period (e.g., changes in TOC concentration from year to year can significantly affect DBP levels). DBP data should not be used for the purpose of estimating *average* residence time because DBP formation is complex and dependent on many factors. (See Appendix B for a discussion of DBP formation.)

If your system has extensive non-compliance TTHM and HAA5 data at a variety of sites throughout your distribution system, you may wish to consider completing an SSS based on your historical data, possibly with a limited amount of new monitoring. See Chapter 3 if you think you may be able to use historical data alone or in combination with other data for an SSS.

<u>High TTHM and High HAA5 Sites</u>

Regulatory compliance data (including all data collected under the Stage 1 DBPR) are not a definitive source for identifying the representative high TTHM and HAA5 concentrations. There may now be other areas with higher TTHM and HAA5 concentrations that have not been sampled or do not have high historical results due to differences in flow or water quality at the time of sampling. Therefore, historical data should always be used in conjunction with other data sources and tools. Results from a Simulated Distribution System (SDS) test can also be helpful in evaluating TTHM and HAA5 data. (Section 8.4.3 describes the SDS test and how it can be used in conjunction with DBP data to select SMP sites and Appendix D describes the recommended procedure for conducting the SDS test.)

Good candidates for high TTHM and HAA5 sites include:

- Historic sample sites with high TTHM concentrations in areas with long residence times.

- Historic sample sites with high HAA5 concentrations in areas that consistently maintain a disinfectant residual.

- Historic sample sites with TTHM/HAA5 concentrations that are close to the TTHM/HAA5 concentration from an SDS test for maximum residence time.

8.4.3 Simulated Distribution System Laboratory Test

An SDS laboratory test is another tool that can be used in conjunction with Stage 1 DBPR compliance monitoring or other DBP data to select SMP sites. In the SDS test, finished water samples are collected (generally at system entry points) and stored for selected periods of time at chemical and environmental conditions simulating those occurring in the distribution system (e.g., temperature and pH). These samples are analyzed for TTHM and HAA5 concentrations at the end of the selected holding time. Appendix D describes the recommended procedures for conducting an SDS test. Note that this procedure would have to be modified if a system has a booster disinfection station.

One use of an SDS test is to confirm that existing Stage 1 DBPR or other DBP monitoring sites represent the maximum water residence time. For this purpose, SDS samples should be collected in conjunction with (preferably on the same day or 1 to 3 days before) the DBP samples collected from the distribution system. At least one SDS sample should be stored for a period of time approximately equal to the maximum residence time, then analyzed for TTHM and HAA5 concentrations. (*Note: an SDS sample <u>must</u> have a detectable disinfectant residual at the end of the holding time.*) It would also be useful in evaluating results to hold an SDS sample for a period of time equal to your average system residence time. If your maximum residence time is more than 5 days, a third SDS test, at a residence time between the average and maximum residence time, is recommended. All SDS samples should be stored at the same temperature as the distribution system water (see Appendix D for suggested procedures).

If distribution system TTHM of HAA5 results are equivalent to or higher than the SDS maximum residence time TTHM or HAA5 results, you can infer that the site is likely representative of high TTHM or HAA5 levels. Remember that you *cannot* use Stage 1 DBPR sites for the SMP; however, you may wish to investigate other locations with similar hydraulic and disinfectant residual characteristics for your high TTHM SMP sites (and high HAA5 sites if they meet other criteria). Examples 8.13 and 8.14 demonstrate how SDS test results and data from Stage 1 DBPR and operational monitoring sites can be used to select SMP sites.

Example 8.13 Using the SDS Test to Evaluate Operational Monitoring Locations (Big City Water)

Big City Water has collected the following distribution system data and SDS test results.

Sample Location/Type	TTHM (µg/L)	HAA5 (µg/L)
SDS at Maximum Residence Time[1]	*78*	*46*
Stage 1DBPR Max Residence Time #1	**75**	**45**
Stage 1DBPR Max Residence Time #2	71	35
Operational Location #1	**79**	**43**
Operational Location #2	40	50
Operational Location #3	**80**	**45**
Operational Location #4	61	50

Note: In this example, the SDS sample was collected on a Monday; distribution system samples were collected during that week.
[1] Maximum residence time determined using the results of a previously conducted tracer study.

Based upon the SDS results for Big City presented above, the following conclusions can be drawn:

- Stage 1 DBPR max residence time #1 most likely represents high TTHM and HAA5 concentrations.
- Stage 1 DBPR max residence time #2 may represent high TTHM, but not HAA5 (possible biodegradation).
- Operational locations #1 and #3 most likely represent high TTHM and HAA5 concentrations.
- Operational locations #2 and #4 represent only high HAA5 concentrations.

For this example, high TTHM SMP sites should be located in areas with similar characteristics to Stage 1 DBPR max residence time #1 and #2, or operational locations #1 and #3. High HAA5 sites should be located in areas with similar characteristics to operational locations #2 and #4 (as long as there is a disinfectant residual concentration).

Example 8.14 Using the SDS Test to Evaluate Operational Monitoring Locations (Blue Ridge Water)

Blue Ridge Water has the following SDS and distribution system data.

Sample Location/Type	TTHM (μg/L)	HAA5 (μg/L)
SDS at Maximum Residence Time[1]	*100*	*67*
Stage 1DBPR Max Residence Time #1	**98**	**55**
Stage 1DBPR Max Residence Time #2	72	58
Operational Location #1	65	45
Operational Location #2	**95**	**62**
Operational Location #3	**91**	**72**
Operational Location #4	80	62

Note: In this example, the SDS sample was collected on a Monday; distribution system samples were collected during that week.
[1] Maximum residence time calculated using an hydraulic model.

Based upon the SDS results for Blue Ridge presented above, the following conclusions can be drawn:

- Stage 1 DBPR max residence time #2 may not be representative of high TTHM concentrations.
- Operational locations #2 and #3 most likely represent high TTHM and HAA5 concentrations.
- Operational location #4 represents only high HAA5 concentrations.

For this example, high TTHM SMP sites should be located in areas with similar characteristics to Stage 1 DBPR max residence time #1 or operational locations #2 and #3. High HAA5 sites should be located in areas with characteristics similar to operational location #4 (as long as there is a disinfectant residual concentration and no evidence of bacteriological activity).

SDS results must viewed with caution. Distribution system conditions are complex and cannot be perfectly replicated in the laboratory, so some error is expected. Also, if you do not have a good idea as to your true maximum distribution system residence time, your SDS results may indicate your Stage 1 DBPR sites are inadequate when, in fact, they are representative of maximum residence time. Similarly, if the SDS test conditions are not representative to the treatment (i.e., source and finished water quality) and distribution system conditions, the test results can be misinterpreted. If your system uses booster chlorination, the SDS test should be run for a finished water sample and a sample taken after the addition of the booster disinfectant dose.

Another use of an SDS test is to help describe DBP formation in the distribution system and, in conjunction with Stage 1 DBPR compliance monitoring and other data, determine average and maximum residence time. Appendix D describes how SDS tests can be used to estimate average and maximum residence time using DBP and chlorine residual data.

8.4.4 Models

A water distribution system model is a computer program that simulates the hydraulic behavior of water in a distribution system. Water distribution system models are widely used in the water industry for planning and operations. Several public domain and commercial software modeling packages are available. For instance, EPA developed a water quality modeling software package, EPANET, that is available without charge via the internet. Your water distribution system model should be adequately calibrated when selecting SMP sample sites (see Chapter 3 for a discussion of model calibration).

> To obtain a **free** copy of EPANET go to:
>
> http://www.epa.gov/ordntrnt/ORD/NRMRL/wswrd/epanet.html

A water distribution system hydraulic model can predict water age in a distribution system when it is run under extended period simulation conditions (i.e., water production, demand, etc., are allowed to change over time). In addition, most models can track the movement of water from each plant or supply point through the distribution system. Model results can provide a picture of the influence zone of each entry point and identify blending zones.

The size of your system and the degree of *skeletonization* of your hydraulic model will determine how useful the model can be for selecting SMP sites. Skeletonization refers to the degree of detail relating to distribution system piping in your model. Highly skeletonized models may only show large distribution mains and omit much of the smaller piping in individual subdivisions or other areas of the distribution system. In such cases, highly skeletonized models may be of limited use in large systems where small pipes account for significant localized increases in system residence time. Because hydraulic models usually are somewhat skeletonized and have varying degrees of calibration and accuracy of demand allocation, best professional judgement should always be used when analyzing the results and using model outputs to assist in the selection of preliminary sites.

It is highly recommended that existing, calibrated water distribution and water quality models be used to estimate water age, identify influence zones, and identify mixing zones to help select SMP sample sites. If a model does not already exist, the time and expense to create a new model and train staff *solely for use in selecting IDSE SMP sample sites* may not be justified. Model development or enhancement may be justified if you intend to employ the model for other uses in addition to the selection of SMP sample sites.

If you have an existing, detailed, well calibrated distribution system model, as well as appropriately trained staff to operate the model and evaluate results, you may wish to consider completing an SSS based on the use of your model and a limited amount of new testing. Chapter 3 describes the requirements for an SSS using a water distribution system model.

8.4.4.1 High TTHM Sites

Water distribution system modeling software can be used to identify high residence time locations (most often your high TTHM sites) when used in the Extended Period Simulation (EPS) mode. When the run time of an EPS model is long enough to produce a consistent pattern of water age values at all nodes, sometimes with repeating fluctuations due to diurnal variations in water demands, then the water age values at the model nodes can be used for the purpose of identifying high residence time locations.

One way to show high residence time locations is by color coding each model node according to its residence time. High TTHM sites should be chosen from the area or areas of the distribution system where the high residence time model nodes are located. The sample sites do not have to be chosen at the *exact* location of a model node, just in the general area identified by the model results.

Precautions in using model data to select high TTHM/HAA5 sites include:

- If no water demand is applied to dead-end nodes in a model or if the water demand in a dead-end is highly uncertain, the water age results for those nodes can be unrealistic and meaningless.

- The accuracy of water age estimates from a model generally decreases as the model moves from large diameter mains to small diameter mains to subdivision piping and dead-ends. This is due to the increasing uncertainty in water usage rates as one moves from large, aggregate demands to smaller demands exerted by a few customers or a single customer.

- If the model is skeletonized, the model results for high residence time areas should be compared to maps of the actual distribution system piping and to actual customer locations in those areas before sample sites are finalized in order to assure that the sample site is representative of the actual distribution system and not just the skeletonized model in the high residence time areas.

- Residence time is just one factor for identifying high TTHM sites and should be compared with other distribution system data (e.g., disinfectant residual data) before making your preliminary SMP site selections.

Because water distribution system models usually are somewhat skeletonized and have varying degrees of calibration and accuracy of demand allocation, best professional judgement should always be used when analyzing the results and using model outputs to assist in the selection of preliminary SMP sample sites.

Blending Zones

In some cases, there may be zones in the distribution system where water flowing from opposite directions meet. This can occur in:

- Long, looping mains

- The interface of the influence zones of two or more different supply points

- Areas where different pressure zones meet within one system

This type of area is sometimes called a “blending zone” and may act as a hydraulic dead-end. Blending zones can occur anywhere in the distribution system, but they more often occur in the central portion of a distribution system. If the water demand around the blending zone is low, then the water age and TTHM and HAA5 concentrations could be high. Hydraulic models can be useful in locating blending zones and identifying high TTHM or HAA5 locations within the blending zone.

8.4.4.2 High HAA5 Sites

The criteria and procedure for selecting preliminary high HAA5 SMP sites using a water distribution system model is generally the same as that described for selecting high TTHM sites with one important difference: the locations chosen to represent high HAA5 must have a detectable disinfectant residual. HAA5 concentrations typically increase in distribution systems as water age increases but can also decrease if disinfectant residuals are not present and biological activity is high. High HAA5 sites should be chosen from locations with a high residence time and a detectable disinfectant residual.

8.4.4.3 Average Residence Time Sites

Average residence time SMP sites can be selected from locations with residence times close to the *flow-weighted* mean of all nodal residence times (or system average). As with selecting high TTHM/HAA5 sites, color coding nodes by nodal residence time can be helpful. SMP sample sites should be chosen from the area or areas of the distribution system where the nodal residence time is close to the system average. The SMP sample sites do not have to be chosen at the *exact* location of a model node, just in the general area identified by the model results.

8.4.5 Tracer Studies

Tracer studies can be used to determine actual water residence times in a distribution system under specific conditions and are sometimes used to calibrate water distribution system models. They are particularly useful for predicting water residence time in areas of a system where there is uncertainty about true pipe diameters due to poor records or the buildup of corrosion deposits affecting system hydraulics. When pipe diameters in a model are inaccurate, model predictions can be very different from the actual hydraulic conditions in a distribution system.

You can perform a tracer study by monitoring the concentration of a conservative constituent (i.e., a chemical that does not degrade over time) through the distribution system. Chemicals used for tracers must not be harmful to people or the environment. Tracer chemicals can be substances that are:

- Specially injected or normally injected in the water for treatment purposes (e.g., hydrofluorosilic acid or sodium fluoride)

- Characteristic of the finished water (e.g., hardness, conductivity)

Before injecting any tracer, a baseline concentration of the tracer in the distribution system water should be determined (fluoride, the most common tracer, may be normally present in trace amounts). If your system adds fluoride, you can turn off the fluoride feed for a period of time, and monitor the resulting decrease of its concentration throughout the distribution system.

If you do not routinely add fluoride to the finished water, you can conduct tracer tests by injecting a small dose of fluoride (about 1 mg/L) into the water entering the distribution system. However, flouride can interact with the material deposited inside pipes and storage facilities, reducing the accuracy of the calculated residence times. As a result, you must inject sufficient fluoride to meet the “fluoride demand” of your distribution system while assuring that fluoride concentrations in the distribution system do not exceed allowable concentrations of 4 mg/L (the primary maximum contaminant limit (MCL) for fluoride is 4 mg/L and the secondary MCL which is non-enforceable is 2 mg/L). If other tracers are used such as calcium chloride or sodium chloride, State environmental agencies may require that food grade chemicals are used or that other assurances are made concerning the safety of the tracer. With some tracer chemicals, systems may want to consider notifying sensitive users.

When selecting tracer monitoring locations, you should consider the following:

- Major intersections or branches in large transmission mains
- Branches in minor mains where flow is split between two or more groups of customers
- Storage tanks
- Entry points to large commercial or industrial users
- Prior to the last fire hydrant in remote areas with few customers

To adequately characterize distribution system residence time, tracer concentrations should be measured frequently and in relatively close proximity to one another. The frequency of sampling will determine the accuracy of the study results. For example, if sampling is conducted every 8 hours the water age at a given location will only be accurate to within 8 hours. Furthermore, the proximity of sample locations to one another will also affect the accuracy of the study results. It may be appropriate to space samples far apart on large transmission mains, but within the distribution system (which contains many piping and hydraulic interactions) samples should be located closer together.

Optimally, tracer studies should be conducted under conditions that represent high DBP formation (typically summer months). Also, the study should be detailed enough to provide good characterization of the entire distribution system. Not all extremities must be covered by the study, but the data must be complete enough to allow for a reasonable extrapolation of the results to cover the entire distribution system.

Although tracer studies often provide very good information, they can be time consuming and costly. Conducting a tracer study solely for the IDSE SMP may not be cost effective. However, if you are considering a tracer study for some other purpose (e.g. calibration of a water distribution system model), consideration should be given to using the tracer study as a tool for the IDSE SMP.

Results from *previously conducted* tracer studies may be very useful in identifying areas in the distribution system with high and average residence times. Typically, the study should have been conducted within the past 10 years and represent the existing distribution system configuration. However, if your system has implemented operational changes that permanently and significantly changed the flow of water through your distribution system (i.e., new transmission mains, addition of large industrial users, significant development in formerly unpopulated or remote areas, etc.) since your tracer study, the study will be of limited use in selecting SMP sample locations.

If you have recently conducted or are planning to conduct a detailed tracer study of your system, you may want to consider completing an alternative SSS (see Chapter 3).

1) High TTHM and High HAA5 Sites

High residence time locations should be identified on a map of the system based on the tracer study field results. SMP sample sites should be chosen from the area or areas of the distribution system where these high residence time tracer study sites are located. The SMP sample sites do not have to be chosen at the exact location of the tracer study monitoring sites, just in the general area identified by the study.

When selecting high TTHM and high HAA5 sites based on tracer study results it is important to remember that residence time is just one factor in identifying high TTHM and high HAA5 sites. Residence time estimates should be compared with other distribution system data (e.g., disinfectant residual data) before making your final sample site selections. Areas with high residence time but low or no disinfectant residual may have microbiological activity which can degrade HAA5. Consequently, high HAA5 sites may not necessarily be located at areas with high residence times.

2) Average Residence Time

The residence time at all sites sampled during the tracer test field effort should be plotted on a map of the system. The overall system average age should be calculated by determining the median residence time results obtained during the field test. Sites with residence times approximately equal to the median of tracer study results should be identified on the map and the required SMP sample sites chosen from within these areas.

8.4.6 System Operating Data

System operating data, such as pump run times, pumping rates, tank level data or flow rates, metered flows between pressure zones, and demand data for large users may be helpful in understanding overall water flow patterns in your distribution system. For example, storage tank configuration and operation can have a significant impact on maximum and average residence times in the areas of a system “downstream” of the storage tank. Pumping rates and flow metering between pressure zones can provide a direct indication of the movement of water through your system. A review of billing records can identify your largest customers. Areas of your system “upstream” of your largest customers are likely to have fresher water than areas downstream of these customers.

8.4.7 Geographic Information System (GIS)

Geographic information system (GIS) software is capable of assembling, storing, manipulating, and displaying geographically referenced data. ArcView and Intergraph are examples of two packages currently available. GIS allows large amounts of distribution system data to be compiled and users to query those data to identify areas in a distribution system meeting specified criteria. It is equivalent to plotting various data on individual see-through maps and laying those maps on top of each other so all data can be viewed together (Figure 8.2 depicts this concept).

Figure 8.2 Conceptual Diagram of GIS

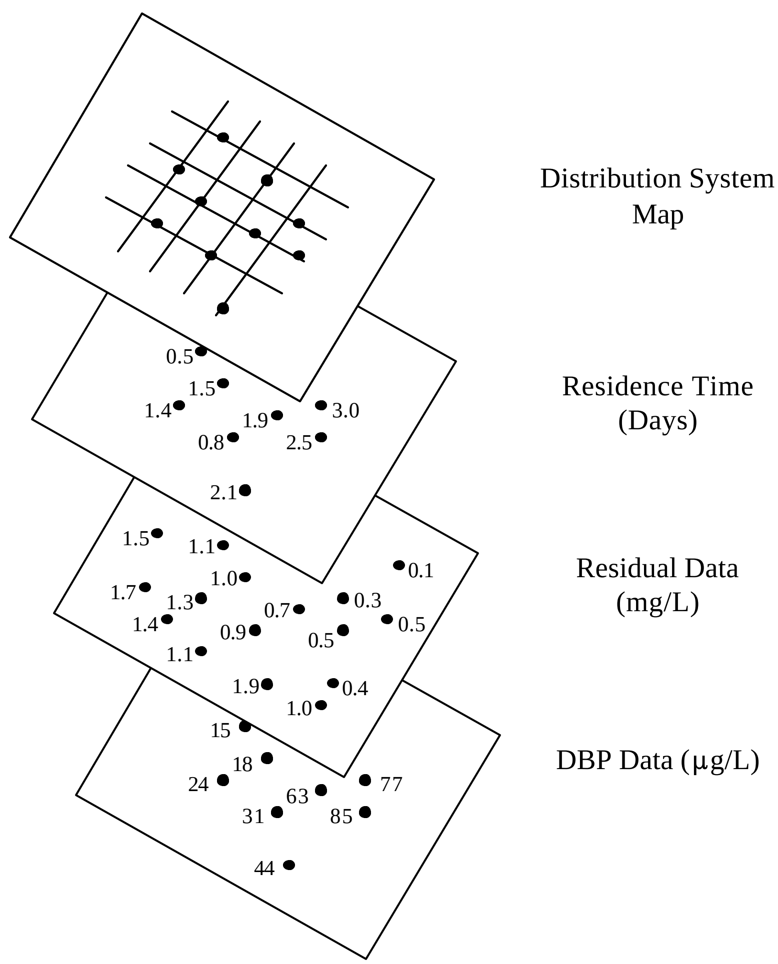


Table 8.4 summarizes the data storage capabilities of a typical GIS application.

Table 8.4 Summary of GIS Data Storage Capabilities

General System Data	Structural Data	Operational Data	Water Quality Data
Land uses and zoning Population density	Pipe diameter and length Valves and fittings Pumps Pipe age Pipe material Pipe maintenance history	Pipe velocities System pressure Pressure zones Residence time	Temperature Residual disinfectant Total coliforms HPC DBPs

While GIS applications can be a valuable tool for evaluating many types of distribution system data geographically, they are not hydraulic models and cannot predict system conditions. GIS applications are a framework for displaying information related to your distribution system. This means residence times, system pressures, pipe velocities, and other operational data should be collected by some other method (e.g., hydraulic model or field measurements) and entered into the GIS database.

After hydraulic and water quality data are integrated into a GIS application, users can query the data to locate areas which meet several criteria for SMP sites. For example, a user may request locations where the residence time exceeds 4 days, the free chlorine residual is between 0.2 and 0.5 mg/L, and the HPC count is less than 500 cfu/mL. Most GIS applications can highlight those locations on a map of the distribution system. The user can then select geographically diverse locations from these areas for the purposes of IDSE SMP monitoring.

The procedure by which GIS identifies preliminary SMP sample locations is similar to the process an individual might use if they were doing the analysis by hand. However, GIS is capable of looking at a larger amount of data in an integrated manner, without the excess time of plotting the data manually. Purchasing a GIS application solely for the purpose of conducting the IDSE may not be efficient because there will be a considerable effort involved in getting the system up and running. However, if your system currently utilizes or is planning to purchase a GIS application, consideration should be given to using the application as a tool for identifying SMP sites.

8.5 Methodology for Selecting Final SMP Sites

As described in the previous section, various data sources and tools can be used to identify SMP sites, but some may provide more accurate estimates of high TTHM and HAA5 locations or average residence time locations than others. How do you prioritize the data and combine data sources and tools to select final SMP sites? This section addresses this question by providing general guidelines for (1) identifying all possible preliminary SMP sites and (2) narrowing down the preliminary sites to final SMP sites. Detailed guidance for identifying preliminary sites using *each* data source or tool was provided in section 8.4—this section focuses on combining tools to select preliminary and final sites.

A key to selecting final SMP sites is the ability to <u>plot</u> preliminary sites on a detailed map of your distribution system. You should always visually confirm that SMP sites provide geographic coverage of the distribution system and are in expected areas of high and average residence time (as predicted by a hydraulic model or other data source) and that you are not missing key areas that may not have been sampled in the past. If you have GIS capabilities, queries can be extremely useful in automating the site selection process. In particular, GIS queries can be used to evaluate multiple data sources for you rather than having you perform the time consuming process of evaluating multiple parameters by hand or in a spreadsheet.

The information and considerations presented in this section are not intended to be limiting or prescriptive. EPA recognizes DBP formation is system-specific and the guidance provided in this manual will not apply to every system. The operational experience and knowledge of system personnel and all available information should be considered in selecting SMP sample sites. Best professional judgement should be exercised in the specific application of guidelines in this manual.

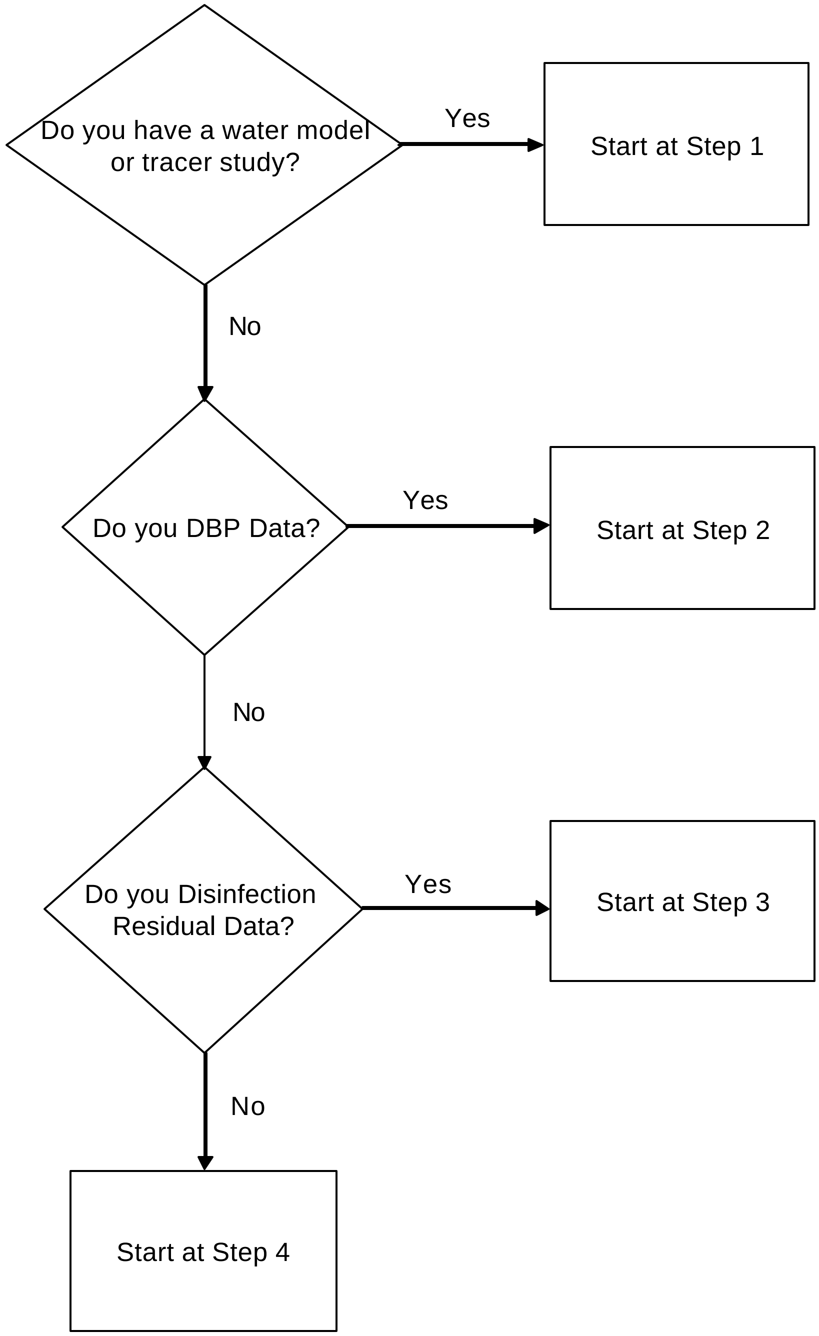
8.5.1 Identifying Preliminary Sites Using Combinations of Tools and Data Sources

This section contains a multi-step process that allows you to use any combination of the following data sources with maps to select preliminary sites:

- Water distribution system model outputs
- Tracer study results
- Disinfectant residual data
- DBP data

All steps involve plotting preliminary sites on a map of your distribution system. Figure 8.3 is flow-chart that indicates at which step you should start, depending on your available data sources.

Figure 8.3 Starting Point for Preliminary Site Selection



The steps in this section focus on identifying preliminary ***high TTHM and high HAA5 sites*** at locations of high residence time. Guidance for selecting average residence time sites (for 100 percent purchasing systems serving at least 10,000 people and for producing surface water serving at least 10,000) is presented separately at the end of each step.

Step 1 - Using Modeling and Tracer Study Results

Identifying Preliminary High TTHM and High HAA5 Sites Residence Time Sites

Use output from your water distribution system model or tracer study results to identify areas with the highest residence times. You should identify at least **twice** as many preliminary SMP sites as required. For example, from Table 8.1 producing ground water systems serving 500 to 9,999 people must have one high TTHM and one high HAA5 site per plant for the SMP; therefore, they should select at least two preliminary high TTHM sites and two preliminary high HAA5 sites per plant using model or tracer study data. Plot all preliminary sites on a map of your distribution system.

Identifying Preliminary Average Residence Time Sites

Use output from your water distribution system model or tracer study results to identify areas with average residence times. You should identify at least **twice** as many preliminary SMP sites as required.

- For 100 percent purchasing systems serving at least 10,000 people, see Table 8.1 for the number of average residence time sites that are required for the SMP. (100 percent purchasing systems serving less than 10,000 people do not have to select average residence time sites).

- For producing systems providing surface water in whole or in part, at least **four** preliminary sites per plant should be identified (two SMP sites per plant are required).

Plot all preliminary average residence time sites on a map of your distribution system.

Step 2 - Using TTHM and HAA5 Data

Note: DBP data are generally not useful in identifying average residence time sites. Only preliminary high TTHM and high HAA5 sites are covered in this step.

<u>*If you completed Step 1:*</u>

Determine if the high TTHM and HAA5 locations correspond to areas with high water residence time. It is possible that the water distribution system model or tracer study did not capture mixing effects or other factors leading to higher residence times than predicted. If the high TTHM and

HAA5 data occur outside predicted areas of high residence time, you should select additional preliminary sites to cover these areas.

*If you did **not** complete Step 1:*

Review TTHM and HAA5 data and identify areas with the highest TTHM and HAA5 concentrations (and/or areas with similar characteristics to sites with high TTHM and HAA5 concentrations). Plot these areas on your distribution system map.

Step 3 - Using Disinfectant Residual Data

If you completed Step 1:

Identifying preliminary high TTHM and high HAA5 sites residence time sites:

On a map of your system, identify areas with low disinfectant residual concentration compared to finished water. (It may be helpful to record the average concentration for the summer months or the minimum monthly concentration on a map of you system). Determine if the areas with high residence times identified in Step 1 correspond to areas with low disinfectant residuals. (Note, the use of booster disinfection will affect this correlation.) It is not unusual for disinfectant residual data to show different trends compared to hydraulic model outputs. It is possible that a hydraulic model or tracer study did not capture mixing effects or other factors leading to higher residence times than predicted. Disinfectant residual can be influenced by other factors, such as internal corrosion, biological activity, etc. (refer to section 8.4.2.1 for a more complete description of other factors affecting disinfectant residual decay). Thus, low disinfectant residual is not a definitive indication of long residence time.

If areas with low disinfectant residuals are identified outside predicted areas of high residence time, you may wish to select additional preliminary SMP sites to cover these areas. For preliminary high HAA5 sites, a minimum residual of 0.2 mg/L chlorine or 0.5 mg/L chloramine should be present.

Identifying preliminary average residence time sites:

On a map of your system, identify areas of average residence time based on disinfectant residual data. (See section 8.4.2.1 for guidance on identifying areas of average residence time using disinfectant residual data.) Do average residence time sites identified by your water distribution system model or tracer study in Step 1 correspond with average residence time sites identified by evaluating disinfectant residual data? Identify additional preliminary SMP sites for average residence times if your residual data show different locations than results from your model or tracer study.

*If you did **not** complete Step 1*:

Identifying preliminary high TTHM and high HAA5 sites residence time sites

Evaluate your disinfectant residual data from warmer months and identify areas with the lowest or no residual concentrations. These locations are likely those with the highest residence time, and represent potential locations for high TTHM and HAA5 SMP sites. (High HAA5 sites should be limited to those sites with a free chlorine residual of at least 0.2 mg/L or a chloramine residual of at least 0.5 mg/L.) Identify at least **twice** as many SMP sites as required. Plot these areas on your distribution system map.

Identifying preliminary average residence time sites

Using disinfectant residual data from your TCR monitoring locations (and flow data, if available), calculate the average system and locational average disinfectant residuals. Section 8.4.2.1 discusses these methodologies. Identify those locations with average disinfectant residuals approximately equal to the system average. Identify at least **twice** as many preliminary SMP sites as required. Plot these areas on your distribution system map.

Step 4 - Map Review

Review your water distribution system map to identify additional preliminary SMP locations representative of high TTHMs and high HAA5 not identified in Steps 1 through 3 where:

- There is light development or low residential population far away from a treatment plant
- An area is served by one or more distribution system storage facilities, especially if the storage facility(s) have high water residence times
- An area is served by booster disinfection stations

You should *not* select preliminary sites at the very end of a water main past the last customer. A better location would be at the last group of customers.

8.5.2 Selecting Final SMP Sites from Preliminary Sites

The following are general guidelines for choosing final SMP sites from your list of preliminary sites identified in accordance with section 8.5.1. Specific guidelines for very small systems serving less than 500 people are at the end of section 8.5.2.1. EPA recognizes there are system-specific factors that may lead you to select final sites that do not specifically meet these guidelines. If you deviate from the guidelines, provide justification to your State in your IDSE Report.

8.5.2.1 Selecting High TTHM and HAA5 SMP Sites (All Systems)

1) Select SMP sites in hydraulically different areas (i.e., do not select two sites close to one another).

2) Select SMP sites in geographically different areas and separated from existing Stage 1 DBPR sites.

3) Prioritize sites that meet the most siting criteria and those identified based on more than one data source. For example, a preliminary high TTHM site that has low disinfectant residual, is near the edge of the distribution system and is downstream of a tank would be a likely SMP site.

4) Select high TTHM sites located after storage facilities and booster disinfection stations.

5) Select high TTHM sites in areas with the lowest or no residual disinfectant (unless your system uses booster disinfection).

6) Generally, select high HAA5 sites with a minimum of 0.2 mg/L chlorine residual or 0.5 mg/L chloramine residual for all observations.

7) Locate at least one of your high TTHM sites in a remote area of your distribution system. If you are only required to select one high TTHM site, it is strongly recommended that you locate this site away from the treatment plant, near the last group of customers (but prior to the last fire hydrant).

8) DBP data are important as long as they represent your current system configuration. If you have a historical TTHM or HAA5 data in an area, these data can be used to prioritize sites (or select one over another) when other data shows no difference between the sties. For example, if disinfectant residual data are the same for three sites over the same periods, then the DBP data can be used to select a high TTHM/HAA5 site.

Special Considerations for Storage Tanks

9) Understanding the impact of storage tanks on water movement and water age in a distribution system is complicated by a variety of specific physical and operational characteristics. The mixing characteristics of storage tanks are impacted by the inlet/outlet piping configuration, inlet momentum, temperature, and duration of drain/fill cycles. For example, horizontal inlets at the base of storage tanks, oversized inlet piping which results in low inlet momentum, and short drain/fill cycles are all potential causes of poor mixing in storage tanks. A methodology for evaluating storage tank mixing characteristics is presented in *Water Quality Modeling of Distribution System Storage Facilities* (Grayman et al. 2000).

   Tanks with poor mixing characteristics and common inlet/outlet piping may operate in a "last in–first out" mode, meaning that the freshest water in the tank is the first to be discharged during a drain cycle. During periods of higher than normal demand, when drain periods may be extended, these tanks may discharge water from the upper regions of the tank where water age is substantially (e.g., several days or weeks) higher than water in the lower regions of the tank. If you suspect poor mixing in one or more of your storage tanks, areas receiving the stored water from those tanks may occasionally have high DBP concentrations.

   Tank level data can be used to assess the theoretical average residence time of water in a tank; however, the mixing characteristics of the tank must be thoroughly understood to adequately estimate the true average water age in a storage tank (Uber et al. 2002). It is important to understand that distribution system storage facilities can have significant but variable impacts on water age. As a result, high TTHM and HAA5 sites should typically be located downstream of distribution system storage facilities.

Specific Guidance for Systems Serving Less Than 500 People

10) Select a high TTHM site in a high residence time area that is not near your Stage 1 DBPR site. (Your Stage 1 DBPR site should be located in an area of your distribution system that represents your maximum residence time.)

11) Locate your high HAA5 site in a location other than near your high TTHM and Stage 1 DBPR sites. If those two sites cover the high residence time areas of your distribution system, then select a site in an area with average residence time (see section 8.4.2.1 for determining average residence time based on disinfectant residual data) for your high HAA5. The highest HAA5 concentrations may not occur at the highest residence time locations. There may be system-specific factors that cause HAA5 to biodegrade and, therefore, areas with average residence time may have the highest HAA5 concentrations.

8.5.2.2 Selecting Average Residence Time Sites

SMP sites representing average residence time are required for:

- 100 percent purchasing systems serving at least 10,000 people
- Producing surface water systems serving at least 10,000 people

From the preliminary average residence time sites, select final average residence time sites that are geographically diverse from the other SMP sites and existing Stage 1 DBPR average residence time compliance sampling sites.

8.6 Stage 2B DBPR Site Selection and IDSE Reporting Requirements (40 CFR 141.605)

Once the SMP monitoring period has ended, the Stage 2B compliance monitoring sites can be selected from the SMP and Stage 1 DBPR results (or Stage 2A DBPR for systems on the late IDSE schedule). Selection must be based on the average TTHM and HAA5 concentrations measured over the SMP monitoring period at each site, or locational running annual averages (LRAAs). Tables 8.5 and 8.6 summarize the Stage 2B site requirements for 100 percent purchasing and producing systems, respectively.

TTHM and HAA5 LRAAs are the most important factors to consider when selecting Stage 2B DBPR monitoring locations. However, the rule allows for some flexibility in selecting Stage 2B compliance sites. Other factors should be considered and may lead to selecting a site with a slightly lower LRAA over another site. The following conditions are possible reasons why you may select a site with a lower LRAA over another site:

- The site provides for more complete geographic coverage of the entire distribution system
- The site allows you to maintain an historical record
- Sampling at that site provides the opportunity to collect other water quality or operational data (e.g., chloramine systems may want to collect nitrate data at that location)

If you do not use your highest TTHM and HAA5 LRAAs to select your Stage 2B DBPR sites, you must provide justification for your selection in your IDSE report.[1]

[1]The Stage 2 DBPR does not specify a difference between two LRAAs that allows selection of a site with the lower LRAA for Stage 2B. EPA recognizes there is uncertainty and variability associated with the TTHM and HAA5 data quality. While the LRAA calculation reduces the impact of these to some extent, they can cause a small difference between two LRAAs to be statistically insignificant and thus, making the selection of the Stage 2B site dependent on other factors. The intent of the Stage 2 DBPR is to reduce peak DBP concentrations in the distribution system. You should use best professional judgment to select Stage 2B sites with consideration to the intent of the rule and demonstrate to the State the reason for the selection.

Table 8.5 Stage 2B Compliance Monitoring Requirements for 100 Percent Purchasing Systems[1,2]

System Size (Population Served[3])	Number of Distribution System Sites (by location type) per System			Total Number of Sites per System	Monitoring Frequency[4]
	Stage 1 Average Residence Time Site	Highest TTHM	Highest HAA5		
Surface Water Systems[5]					
< 500	-	1	1	**2[5]**	Every 365 days
500 - 4,999	-	1	1	**2[5]**	Every 90 days
5,000 - 9,999	-	1	1	**2**	Every 90 days
10,000 - 24,999	1	2	1	**4**	Every 90 days
25,000 - 49,999	1	3	2	**6**	Every 90 days
50,000 - 99,999	2	4	2	**8**	Every 90 days
100,000 - 499,999	3	6	3	**12**	Every 90 days
500,000 - 1,499,999	4	8	4	**16**	Every 90 days
1.5 million - < 5 million	5	10	5	**20**	Every 90 days
≥ 5 million	6	12	6	**24**	Every 90 days
Ground Water Systems					
< 500	-	1	1	**2[6]**	Every 365 days
500 - 9,999	-	1	1	**2**	Every 365 days
10,000 - 99,999	1	2	1	**4**	Every 90 days
100,000 - 499,999	1	3	2	**6**	Every 90 days
≥ 500,000	2	4	2	**8**	Every 90 days

[1] (40 CFR 141.605 (e))

[2] For the purpose of this guidance manual, *100 percent purchasing systems* are those systems that buy or otherwise receive all of their finished water from one or more wholesale systems year-round.

[3] *Population served* is usually a system's retail population. It should not include populations served by consecutive systems that purchase water from that system.

[4] Monitoring frequency is the approximate number of days between monitoring events. A dual sample set must be collected at each location, unless otherwise noted. A dual sample set is one TTHM and one HAA5 sample that is taken at the same time and location.

[5] For the purpose of this guidance manual, "surface water systems" are equivalent to subpart H systems (i.e., any system that uses surface water or GWUDI as a source, including all mixed systems that use some surface water or GWUDI and some ground water).

[6] Dual sample sets are not required at both the high TTHM and the high HAA5 site—if the highest TTHM and HAA5 levels occur at a different locations, then only one sample is collected at each location. If they occur at the same location, then a dual sample set is collected at that location.

Table 8.6 Summary of Stage 2B Compliance Monitoring Requirements for Producing Systems[1,2]

System Size (Population Served[3])	Number of Distribution System Sites (by location type) per Plant[4]			Total Number of Sites per Plant	Monitoring Frequency[5]
	Stage 1 Average Residence Time Site	Highest TTHM	Highest HAA5		
Surface Water Systems[6]					
< 500	-	1	1	**2**[7]	Every 365 days
500 - 9,999	-	1	1	**2**	Every 90 days
≥ 10,000	1	2	1	**4**	Every 90 days
Ground Water Systems					
< 500	-	1	1	**2**[7]	Every 365 days
500 - 9,999	-	1	1	**2**	Every 365 days
≥ 10,000	-	1	1	**2**	Every 90 days

1 (40 CFR 141.605 (a))
2 For the purpose of this guidance manual, *producing systems* are those that do not buy 100 percent of their water year-round (i.e., they produce some or all of their own finished water).
3 *Population served* is usually a system's retail population. It should not include populations served by consecutive systems that purchase water from that system.
4 For the purpose of the Stage 2 DBPR compliance monitoring, a plant can be either a treatment plant (that provides, at a minimum, disinfection using a disinfectant other than UV) or a consecutive system entry point that operates for at least 60 consecutive days per year.
5 Monitoring frequency is the approximate number of days between monitoring events. A dual sample set must be collected at each location, unless otherwise noted. A dual sample set is one TTHM and one HAA5 sample that is taken at the same time and location.
6 For the purpose of this guidance manual, "surface water systems" are equivalent to subpart H systems (i.e., any system that uses surface water or GWUDI as a source, including all mixed systems that use some surface water or GWUDI and some ground water).
7 Dual sample sets are not required at both the high TTHM and the high HAA5 site—if the highest TTHM and HAA5 levels occur at a different locations, then only one sample is collected at each location. If they occur at the same location, then a dual sample set is collected at that location.

8.6.1 100 Percent Purchasing Systems

The rule requires 100 percent purchasing systems to use the following protocol for selecting Stage 2B sites from IDSE and Stage 1 compliance monitoring data.

1) Site with the highest TTHM LRAA

2) Site with the highest HAA5 LRAA (not previously selected)

3) Existing Stage 1 DBPR compliance monitoring site
4) Site with the highest TTHM LRAA (not previously selected)

Repeat the protocol, selecting from the remaining sites, until the required number has been selected. For #3, alternate between highest HAA5 and highest TTHM of Stage 1 DBPR average residence time sites, not previously selected.

8.6.2 Producing Systems

The rule requires producing systems to select the required amount of sites for each plant using the following protocols:

Large surface water systems

For each plant, select sites with following:

1) Highest TTHM LRAA

2) Highest TTHM LRAA

3) Highest HAA5 LRAA

4) Existing Stage 1 DBPR Average Residence Time site with the highest TTHM or HAA5 LRAA. If you do not have a Stage 1 Average Residence Time site, then you must choose the next highest HAA5 site.

Small surface water systems and all ground water systems

Select sites with the highest TTHM LRAA and HAA5 LRAA for each plant.

- Systems serving 500 to less than 10,000 people—if the highest TTHM and HAA5 occur at the same site for a given plant, then your system may monitor at only that site for that plant.

- Systems serving less than 500—you are required to take one TTHM and one HAA5 sample per year per plant. If the high TTHM and HAA5 for a given plant occurred at different sites, then you only need to collect a TTHM sample at the high TTHM site and a HAA5 sample at the high HAA5 site.

8.6.3 Examples of Stage 2B DBPR Site Selection

This section provides examples of Stage 2B DBPR site selection:

Example 8.15 Selecting Stage 2B DBPR Sites from SMP Data

Example 8.16 Maintaining an Historical Record

Example 8.17 Providing Geographical Coverage When Choosing Stage 2B DBPR Sites

Example 8.15 Selecting Stage 2B DBPR Sites from SMP Data

A producing system serves 90,000 people and has one surface water treatment plant. This system must select **four** Stage 2B DBPR compliance sites (from Table 8.9): two high-TTHM sites; one high-HAA5 site; and one from the three existing Stage 1 DBPR average residence time compliance sites. The table below lists the TTHM and HAA5 LRAAs for all Stage 1 DBPR compliance monitoring sites and three of the eight SMP sites (these data represent the seven highest TTHM and HAA5 LRAAs).

Site	TTHM LRAAs	HAA5 LRAAs
A (Stage 1 max. residence time)	64	39
B (SMP high TTHM site)	66	40
C (SMP high HAA5 site)	72	52
D (SMP high TTHM site)	76	50
E (Stage 1 avg. residence time)	57	48
F (Stage 1 avg. residence time)	42	30
G (Stage 1 avg. residence time)	55	50

Selecting the Average Residence Time Site

The average residence time site should have either the highest TTHM or highest HAA5 LRAA of the Stage 1 DBPR average residence time sites. The water system may choose either Site E (highest TTHM LRAA) or Site G (highest HAA5 LRAA). With two valid options, the site providing the best geographic coverage is preferred. Site G is located downstream of an elevated tank and is the only site that receives water from that tank; therefore, the water system selects **Site G**.

Selecting High-TTHM and High-HAA5 Sites

Sites C and D have both the highest TTHM and HAA5 LRAAs (they can represent the two high-TTHM sites or one high-TTHM site and one high-HAA5). One more high TTHM or high HAA5 site must be chosen between Sites A and B. The differences in LRAAs between Site A and Site B are minimal. Site A was first selected as a THM Rule “maximum” compliance site and is now a Stage 1 site DBPR. To maintain the historic record of sampling, **Site A** is chosen.

Example 8.16 Maintaining an Historical Record

A producing system serves 4,000 people and has one ground water treatment plant. This system must select **two** Stage 2B compliance sites (from Table 8.9): one high-TTHM and one high-HAA5 site. A comparison of SMP and Stage 1 DBPR compliance monitoring results are presented in the table below.

Sample Locations with Highest LRAAs	**LRAA**	
	TTHM (µg/L)	**HAA5 (µg/L)**
SMP #1 High TTHM	*72*	*51*
SMP #2 High TTHM	**65**	**56**
SMP # 3 High HAA5	60	51
Stage 1 DBPR max residence time site	**70**	**51**

Because the TTHM LRAA for the Stage 1 DBPR site is only slightly lower than the maximum TTHM LRAA (SMP #1), the system chooses **the Stage 1 DBPR site over SMP #1** for the Stage 2B DBPR high TTHM site to maintain the historic DBP record at that site. SMP #2 is selected as the high HAA5 site.

8.7 Reporting Results to the State

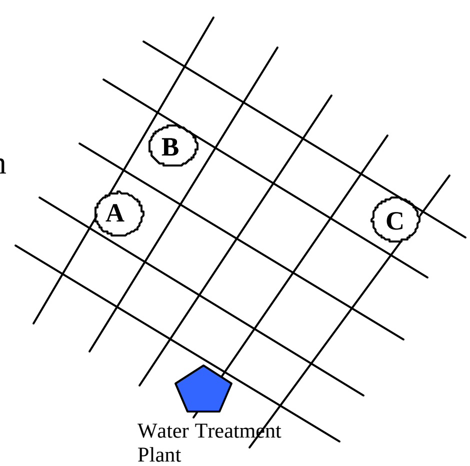
The rule requires the following data and information be included in your IDSE report to the State (40 CFR 141.604):

- The original SMP plan and an explanation of any deviations from that plan
- All TTHM and HAA5 analytical results from the SMP
- All TTHM and HAA5 analytical results from Stage 1 DBPR compliance samples collected during the period of the IDSE
- A schematic of your distribution system with the results, location, and date of all IDSE SMP and compliance samples noted
- Data used to justify IDSE SMP site selections
- Proposed Stage 2B compliance monitoring sites with justification for selection of each proposed site
- Proposed month(s) during which Stage 2B monitoring is to be conducted

Example 8.17 Providing Geographic Coverage When Choosing Stage 2B DBPR Sites

In general, the two representative high TTHM sites (per plant) should not be from the same area of the distribution system.

The two highest TTHM LRAAs in the distribution system are from adjacent SMP sample sites (Sites A and B). The site with the third highest TTHM LRAA is on the far side of the distribution system (site C). In this case, consider selecting sites **A and C** or **B and C** as Stage 2B DBPR sites for a broader geographical coverage of the distribution system.



Refer to Appendices E through J for example IDSE reports based on source water and system size (see Table 8.10).

Remember that TTHM and HAA5 data collected for the SMP are not to be included in compliance calculations for the Stage 1 or Stage 2A DBPR. Also, results from the SMP should not be reported in your Consumer Confidence Report.

If you do not receive notification that your Stage 2B site selection was acceptable by [3 years after rule promulgation] for systems on the early schedule or [6 years after rule promulgation] for systems on the late schedule, you should contact your State to verify your Stage 2B sites meet compliance requirements.

Table 8.7 Example IDSE Reports

Appendix	System Characteristics
Appendix E	SMP for Producing Surface Water System (≥ 10,000)
Appendix F	SMP for Producing Ground Water System (≥ 10,000)
Appendix G	SMP for Producing Surface Water System (500 - 9,999)
Appendix H	SMP for Producing Ground Water System (< 10,000)
Appendix I	SMP for Producing Surface Water System (< 500)
Appendix J	SMP for 100 Percent Purchasing Surface Water System

Appendix A

Impacts of an Alternative Population-Based Monitoring Approach

This page intentionally left blank.

A.1 Introduction

The Stage 2 DBPR includes monitoring requirements that were recommended by the Stage 2 M-DBP Federal Advisory Committee (Stage 2 FACA) in the Agreement in Principle (USEPA 2000). Many of these monitoring requirements were based on those in the 1979 TTHM Rule and Stage 1 DBPR. For example, the frequency of monitoring under the Stage 1 DBPR is a function of source water type (ground or surface water), size of system, and the number of plants per system. For the Stage 2 DBPR, as under the Stage 1 DBPR, the Stage 2 FACA recommended that compliance sampling be required on a per-plant basis. This recommendation is based on the assumption that as systems increase in size, they will tend to have more plants and increased complexity of water treatment and distribution, thereby warranting increased monitoring to represent DBP occurrence in the distribution system. The Stage 2 FACA also recommended higher frequency monitoring for systems using surface water than those using ground water because ground water tends to have lower and more stable concentrations of organic DBP precursors than surface water. Furthermore, since many ground water systems have multiple wells/entry points drawing water from the same aquifer, the Stage 2 FACA recommended that these wells be considered as a single plant with the same monitoring requirements prescribed for one plant, if approved by the State.

Upon further analysis of the Stage 2 FACA recommendations, EPA has identified the following issues related to the monitoring requirements of the Stage 2 DBPR:

- Basing increased monitoring on numbers of water treatment plants per system, as opposed to population alone, may result in either excessive or insufficient samples to represent DBP occurrence in the distribution system.

- The proposed sampling requirements for mixed systems (i.e., those receiving surface water and disinfecting ground water in their distribution system) may be excessive, depending upon the system's characteristics.

- The proposed monitoring requirements, based on additional samples per water treatment plant, pose unique implementation issues for systems with temporary supplies during the year.

To address these issues, the Stage 2 DBPR uses two approaches to monitoring for two different groups of systems:

1) **The plant-based approach** is dependent on population served, source water, AND the number of plants in a system (as with Stage 1 DBPR compliance monitoring) and applies to systems that produce some or all of their own finished water (called *producing systems* in

this manual). For the purpose of the Stage 2 DBPR, a plant can be either a treatment plant (that provides, at a minimum, disinfection using a disinfectant other than UV) or a consecutive system entry point that operates for at least 60 consecutive days per year.

- **The population-based approach** that is dependent on population served and source water and applies to only those systems that purchase 100 percent of their finished water from other systems (called *100 percent purchasing systems* in this manual).

Section V(F)(2) of the Stage 2 DBPR preamble describes the monitoring issues in detail and requests comment on them, particularly the significance of a plant-based (the proposed monitoring scheme) versus a population-based monitoring approach (monitoring requirements based on population and source type only).

The purpose of this Appendix is to describe how this guidance manual would be revised if the Stage 2 monitoring scheme were changed to a population-based approach. First, section A.2 presents EPA's proposed framework for an alternative population-based monitoring scheme. Section A.3 then discusses a revised organization and consolidation of chapters for this guidance manual to reflect a population-based approach monitoring scheme for all systems.

A.2 Summary of Alternative Population-Based Approach

The Stage 2 DBPR requires monitoring for (1) the IDSE and (2) Stage 2A and Stage 2B compliance. Currently, monitoring requirements are based on population and source water only for 100 percent purchasing systems, and based on population, source water, and number of plants for producing systems. Under the alternative population-based approach, the proposed monitoring requirements for 100 percent purchasing systems would be applied to all systems. The following exhibits summarize the IDSE and Stage 2B monitoring requirements for the population based approach. (These requirements are identical to those presented in Chapters 1, 4, and 8 for 100 percent purchasing.)

- Table A.1 – IDSE SMP monitoring requirements for Population-based Approach

- Table A.2 – Stage 2B routine samples required for Population-based Approach

Table A.1 IDSE SMP Sampling Requirements for Population-based Approach

System Size (Population Served)	Number of Distribution System Sites[2] (by location type) per System: Near Entry Point[3]	Average Residence Time	High TTHM	High HAA5	Total Number of Sites per System	Monitoring Frequency for the 1-year IDSE period[4]
Surface Water Systems[5]						
< 500	-	-	1	1	**2**	Every 180 days
500 - 4,999	-	-	1	1	**2**	Every 90 days
5,000 - 9,999	-	1	2	1	**4**	Every 90 days
10,000 - 24,999	1	2	3	2	**8**	Every 60 days
25,000 - 49,999	2	3	4	3	**12**	Every 60 days
50,000 - 99,999	3	4	5	4	**16**	Every 60 days
100,000 - 499,999	4	6	8	6	**24**	Every 60 days
500,000 - < 1.5 million	6	8	10	8	**32**	Every 60 days
1.5 million - < 5 million	8	10	12	10	**40**	Every 60 days
≥ 5 million	10	12	14	12	**48**	Every 60 days
Ground Water Systems						
< 500	-	-	1	1	**2**	Every 180 days
500 - 9,999	-	-	1	1	**2**	Every 90 days
10,000 - 99,999	1	1	2	2	**6**	Every 90 days
100,000 - 499,999	1	1	3	3	**8**	Every 90 days
≥ 500,000	2	2	4	4	**12**	Every 90 days

1 For the purposes of this manual, 100 percent purchasing systems are those systems that buy or otherwise receive all of their finished water from one or more wholesale systems year-round.

2 A dual sample set must be collected at each location. A dual sample set is one TTHM and one HAA5 sample that is taken at the same time and location.

3 See section 8.2 for requirements when the number of entry points in a system is different from the number of required near-entry point sites in this table.

4 Monitoring frequency is the approximate number of days between monitoring events.

5 For the purposes of this guidance manual, "surface water" systems are equivalent to "subpart H" systems and include systems that provide GWUDI.

Table A.2 Stage 2B Compliance Monitoring Requirements for Population-based Approach

System Size (Population Served)	Number of Distribution System Sites[2] (by location type) per System			Total Number of Sites per System	Monitoring Frequency[3]
	Existing Stage 1 Compliance Sites	Highest TTHM	Highest HAA5		
Surface Water Systems[4]					
< 500	-	1	1	**2**[5]	Every 365 days
500 - 4,999	-	1	1	**2**[5]	Every 90 days
5,000 - 9,999	-	1	1	**2**	Every 90 days
10,000 - 24,999	1	2	1	**4**	Every 90 days
25,000 - 49,999	1	3	2	**6**	Every 90 days
50,000 - 99,999	2	4	2	**8**	Every 90 days
100,000 - 499,999	3	6	3	**12**	Every 90 days
500,000 - 1,499,999	4	8	4	**16**	Every 90 days
1.5 million - < 5 million	5	10	5	**20**	Every 90 days
≥ 5 million	6	12	6	**24**	Every 90 days
Ground Water Systems					
< 500	-	1	1	**2**[5]	Every 365 days
500 - 9,999	-	1	1	**2**	Every 365 days
10,000 - 99,999	1	2	1	**4**	Every 90 days
100,000 - 499,999	1	3	2	**6**	Every 90 days
≥ 500,000	2	4	2	**8**	Every 90 days

[1] For the purposes of this manual, 100 percent purchasing systems are those systems that buy or otherwise receive all of their finished water from one or more wholesale systems year-round.

[2] A dual sample set must be collected at each location, unless otherwise noted. A dual sample set is one TTHM and one HAA5 sample that is taken at the same time and location.

[3] Monitoring frequency is the approximate number of days between monitoring events.

[4] For the purposes of this guidance manual, “surface water” systems are equivalent to “subpart H” systems and include systems that provide GWUDI.

[5] Dual sample sets are not required at both the high TTHM and the high HAA5 site—if the highest TTHM and HAA5 levels occur at a different locations, then only one sample is collected at each location. If they occur at the same location, then a dual sample set is collected at that location.

A.3 Revised Guidance Manual Organization

The IDSE and Stage 2B requirements are less complex with a monitoring scheme that is based only on population served and source water type (the population-based approach) compared to plant-based requirements. Table A.3 hypothesizes how this manual might be revised if the monitoring requirements were to change. Note two chapters will be deleted and no additional chapters will be necessary.

Table A.3 Revised Chapter Organization and Content Reflecting a Population-Based Monitoring Approach for All Systems

Current Chapter	Chapter Revisions
1 - Introduction	Revised. (Remove distinctions between producing and 100 percent purchasing system).
2 - Criteria for IDSE Waiver and Reporting Requirements	Same
3 - System Specific Study	Same
4 - SMP Requirements for 100 Percent Purchasing Systems	Revised to present SMP requirements for <u>all</u> systems, SW and GW.
5 - SMP Requirements for Producing Systems, SW serving $\geq$ 10,000 people	Deleted. Revised Chapter 4 will cover all systems.
6 - SMP Requirements for Producing Systems, SW serving 500 - 9,999 people and GW serving $\geq$ 10,000 people	Deleted. Revised Chapter 4 will cover all systems.
7 - SMP Requirements for Producing Systems, SW serving < 500 people and GW serving < 10,000 people	Revised to address only systems serving less than 500 people. Becomes Chapter 5.
8 - SMP Site Selection and Reporting	Same, becomes Chapter 6.

References

EPA, 2000. Stage 2 M-DBP Agreement in Principle. Microbial/Disinfection Byproducts (M-DBP) Federal Advisory Committee. September 12, 2000.

Appendix B

Factors Affecting Disinfection Byproduct Formation

This page intentionally left blank.

B.1 Introduction

The purpose of this appendix is to identify and discuss the factors that affect formation of disinfection byproducts (DBPs) in water treatment processes and distribution systems. This appendix is intended to serve as a tool for systems for the purpose of identifying IDSE sample locations and Stage 2B monitoring locations. It is divided into the following sections:

B.2 Factors Affecting DBP Formation

Organic DBPs (and oxidation byproducts) are formed by the reaction between organic substances and oxidizing agents (e.g., chlorine and ozone) that are added to water during treatment. In most water sources, natural organic matter (NOM) is the most significant constituent of organic substances and DBP precursors. NOM is often measured as total organic carbon (TOC) and as such the two terms are used interchangeably in much of the discussion presented in this appendix. Major factors affecting the type and amount of DBPs formed include:

- Type of disinfectant, dose, and residual concentration
- Contact time and mixing conditions between disinfectant (oxidant) and precursors
- Concentration and characteristics of precursors
- Water temperature
- Water chemistry (including pH, bromide ion concentration, organic nitrogen concentration, and presence of other reducing agents such as iron and manganese)

B.3 Disinfectant Type

Organic DBPs can be subdivided into halogenated and non-halogenated byproducts. Halogenated organic disinfection byproducts are formed when organic compounds found in water react with free chlorine, free bromine, or free iodine. The formation reactions take place in both the treatment plant and the distribution system. Free chlorine can be introduced to water directly as a primary or secondary disinfectant, as a byproduct of the manufacturing of chlorine dioxide, or as a component in the formation of chloramines for secondary disinfection. Reactions between NOM and chlorine lead to the formation of a variety of halogenated DBPs including THMs and HAAs.

Free chlorine and ozone oxidize bromide ion to hypobromite ion/hypobromous acid, which in turn can react with NOM to form brominated DBPs (e.g., bromoform). The presence of bromide affects both the rate and yield of DBPs. As the ratio of bromide to NOM (measured as total organic carbon) increases, the percentage of brominated DBPs increases. For example, Krasner (1999) reported the rate of THM formation is higher in waters with increased concentrations of bromide. Oxidation of organic nitrogen can lead to the formation of DBPs containing nitrogen, such as haloacetonitriles, halopicrins, and cyanogen halide (Reckhow et al. 1990; Hoigné and Bader 1988). Brominated DBPs can also form by bromine substitution in the chlorinated byproducts. Hypobromous acid is a more effective substituting agent, while hypochlorous acid is a better oxidant (Krasner 1999).

Non-halogenated DBPs may form when precursors react with strong oxidants. For example, the reaction of organics with ozone and hydrogen peroxide results in the formation of aldehydes, aldo- and keto-acids, and organic acids (Singer 1999). Chlorine can also trigger the formation of some non-halogenated DBPs (Singer and Harrington 1993). Many of the non-halogenated DBPs are biodegradable.

Studies have documented that chloramines produce significantly lower DBP levels than free chlorine, and there is no clear evidence that the reaction of NOM and chloramine leads to the formation of THMs (Singer and Reckhow 1999; EPA 1999). Predictions of an empirical DBP formation model calibrated using ICR data indicated that THMs and HAAs are formed in full-scale plants and distribution systems under chloraminated conditions at a fraction of the amount that would be expected based on observations of DBP formation under free chlorine conditions. The amount of formation with chloramines varied from 5 percent to 35 percent of that calculated for free chlorine, depending on the individual DBP species (Swanson et al. 2001).

It is possible that DBPs might form during the mixing of chlorine and ammonia, when free chlorine might react with NOM before the complete formation of chloramines. In addition, monochloramine slowly hydrolyzes to release free chlorine in water. This free chlorine may contribute to the formation of small amounts of additional DBPs in the distribution system. The benefits of low DBP formation with chloramines are especially important at the extremities of the distribution system where high DBP levels can found.

The application of chlorine dioxide does not produce significant amounts of organic halogenated DBPs. Only small amounts of total organic halides (TOXs, the class of halogenated organic by-products that includes THMs and HAAs) are formed. However, THMs and HAAs will form if excess chlorine is added to water to ensure complete reaction with sodium chlorite during the production of chlorine dioxide.

To date, there is no evidence to suggest that ultraviolet irradiation (UV) results in the formation of any disinfection byproducts; however, little research has been performed in this area. Most of the research regarding application of UV and DBP formation has focused on chlorinated DBP formation as a result of UV application prior to the addition of chlorine or chloramines. The evidence suggests UV does not affect chlorinated DBP formation.

Ozone does not produce chlorinated DBPs; however, ozone can alter the reactions between chlorine and NOM and affect the speciation of chlorinated DBPs when chlorine is added downstream. In waters with sufficient bromide concentrations, ozonation can lead to the formation of bromate and other brominated DBPs. Bromate, like THMs and HAAs, is a regulated DBP. Ozonation of natural waters also produces aldehydes, haloketones, ketoacids, carboxylic acids, and other types of biodegradable organic material. The biodegradable fraction of organic material can serve as a nutrient source for microorganisms, and should be removed to prevent microbial regrowth in the distribution system.

B.4 Disinfectant Dose

The concentration of disinfectant can affect the formation of DBPs. In general, changes in the disinfectant dose have a great impact on DBP formation during primary disinfection. This is because the amount of disinfectant added during primary disinfection is usually less than the long-term demand and the disinfectant is the limiting reactant in DBP formation reactions. Although disinfectant dose can affect DBP formation during secondary disinfection, the effect is less significant than in primary disinfection. During secondary disinfection DBP formation reactions may be precursor limited since an excess of disinfectant is added to the water. In the distribution system, DBP formation reactions become disinfectant-limited when the free chlorine residual drops to low levels. Singer and Reckhow (1999) suggested a chlorine concentration of 0.3 mg/L as a rule of thumb.

In many systems booster disinfection is applied to raise disinfectant residual concentration, especially in remote areas of the distribution system or near storage tanks where water age may be high and disinfectant residuals can be low. The additional chlorine dose applied to the water at these booster facilities can increase THM and HAA levels when sufficient precursors remain in the water. Booster chlorination can also maintain high HAA concentrations because the increased free chlorine residual can prevent the biodegradation of HAAs.

B.5 Time Dependency of DBP Formation

In general, DBPs continue to form in drinking water as long as disinfectant residuals and reactive DBP precursors are present. Therefore, the longer the contact time between the disinfectant/oxidant and NOM, the greater the amount of DBPs that can be formed. This accumulation is a consequence of the formation of THMs and HAAs and their associated chemical stabilities, which are generally quite high in the disinfected drinking water as long as a significant disinfectant residual is still present (Singer and Reckhow 1999).

High TTHM values usually occur where the water age is the oldest. Unlike THMs, HAAs cannot be consistently related to water age because HAAs are known to biodegrade over time when the disinfectant residual is low. This might result in relatively low HAA concentrations in areas of the distribution system where disinfectant residuals are depleted.

In contrast to chlorination byproducts, ozonation byproducts form more rapidly, but their period of formation is much lower than that of chlorination byproducts(Singer and Reckhow 1999). This is the result of the quick dissipation of ozone residuals in drinking water treatment plants.

B.6 Concentration and Characteristics of DBP Precursors

The formation of halogenated DBPs is related to the concentration of NOM at the point of chlorination. Greater DBP levels are formed in waters with high concentrations of precursors. Studies conducted with different fractions of NOM have indicated the reaction between chlorine and NOM with high aromatic content tends to form higher DBP levels than NOM with low aromatic content. For this reason, UV absorbance (typically indicated by UV absorbance at 254 nm [UV-254]), which is generally attributed to the aromatic and unsaturated components of NOM, is considered a good predictor of the tendency of a source water to form THMs and HAAs (Owen et al. 1998; Singer and Reckhow 1999). It should be noted, however, that the more highly aromatic precursors, characterized by high UV-254, in source waters are more easily removed by coagulation. Thus, it is the UV-254 measurement immediately upstream of the point(s) of chlorination within a treatment plant that is more directly related to THM and HAA formation potential.

B.7 Water Temperature

The rate of formation of THMs increases with increasing temperature. HAA formation rates may also increase with temperature, though the effects are less pronounced. Consequentially, the highest THM and HAA levels may occur in the warm summer months. However, water demands are often higher in warmer months, resulting in lower water age within the distribution system and helping to control DBP formation. Furthermore, high temperature conditions in the distribution system promote the accelerated depletion of residual chlorine, which can mitigate DBP formation and promote biodegradation of HAAs (unless chlorine dosages are increased to maintain high residuals). (Singer and Reckhow 1999). For these reasons, depending on the specific system, the highest THM and HAA levels may be observed during months which are warm, but not necessarily the warmest.

Seasonal trends affect differently where high THM and HAA concentrations might be found. For example, when water is colder, microbial activity is typically lower and DBP formation kinetics are slower. Under these conditions, the highest THM and HAA concentrations might appear coincident with the oldest water in the system. In warmer water, the highest HAA concentrations might appear in fresher water, which is likely to contain higher disinfectant residuals that can prevent the biodegradation of HAAs.

B.8 Water pH

In the presence of NOM and chlorine, THM formation increases with increasing pH, whereas the formation of HAAs and other DBPs increase with decreasing pH. The increase of THMs at higher pH values is likely due to base catalyzed reactions that lead to THM formation. HAA formation pathway can be altered at high pH since their precursors can hydrolyze (Singer and Reckhow 1999).

The major byproducts of ozonation are not affected by base hydrolysis. However, the rate of decomposition of ozone to hydroxyl radical is accelerated as pH increases. This occurrence is thought to be responsible for the decrease of some byproducts (e.g., aldeydes) and the increase of others (e.g., carbonyl byproduct and total organic halides; Singer and Reckhow 1999). The application of ozone to bromide containing waters leads to the formation of hypobromite and hypobromous acid. At low pH, the equilibrium shifts to hypobromous acid which can react with NOM to form halogenated byproducts such as bromoform and dibromoacetic acid (Singer and Reckhow 1999).

References

EPA, 1999. Alternative Disinfectants and Oxidants Guidance Manual. EPA 815-R-99-014.

Hoigne J., and H. Bader. 1988. "The formation of Trichloronitromethane (chloropicrin) and Chloroform in a Combined Ozonation/Chlorination Treatment of Drinking Water." *Water Resources*. 22 (3):313.

Krasner S. W., 1999. "Chemistry of Disinfection By-Product Formation", in *Formation and Control of Disinfection By-Products in Drinking Water*, Singer P.C. editor, American Water Works Association, Denver CO.

Reckhow, D.A., P.C. Singer, and R.L. Malcom. 1990. "Chlorination of Humic Mateials: Byproduct Formation and Chemical Interpretations." *Environ. Sci. Technol*. 24(11):1655.

Singer, P.C. and D.A. Reckhow. 1999. "Chemical Oxidation." *Water Quality and Treatment*, 5th edition. Letterman R.D. technical editor, American Water Works Association, McGraw-Hill, New York, NY.

Singer, P.C. (editor) 1999. Formation and Control of Disinfection Byproducts in Drinking Water. American Water Works Association, Denver, CO.

Singer, P.C., and G.W. Harrington. 1993. "Coagulation of DBP Precursors: Theoretical and Practical Considerations." Conference proceedings, AWWA Water Quality Technology Conference, Miami, FL.

Swanson, W.J., Z. Chowdhury, R. Summers, and G. Solarik. 2001. "Predicting DBPs at Full-Scale: Calibration and Validation of the Water Treatment Plant Model Using ICR Data" Conference proceedings, 2001 AWWA Annual Conference and Exhibition, Washington, DC.

Appendix C

TTHM and HAA5 Sampling Protocol

This page intentionally left blank.

C.1 Introduction

TTHM and HAA5 samples must be properly collected and analyzed to ensure accurate analytical results. For example, THMs are volatile chemicals, meaning they can move from the liquid phase to the gas phase under ambient conditions. Therefore, care must be taken to make sure that no air bubbles are present in the filled sample vial. This appendix summarizes information on proper sample collection, handling, and laboratory analytical techniques.

C.2 Analytical Methods

Table C.1 lists the analytes that are included in TTHM and HAA analyses.

Table C.1 TTHM and HAA Analytes

Analyte Group Code	Analytes in Group (Abbreviation for Analyte)
HAA5	Haloacetic acids: Dibromoacetic acid (DBAA) Dichloroacetic acid (DCAA) Monobromoacetic acid (MBAA) Monochloroacetic acid (MCAA) Trichloroacetic acid (TCAA)
HAA9	HAA5 plus four additional analytes Bromochloroacetic acid (BCAA) Bromodichloroacetic acid (BDCAA) Chlorodibromoacetic acid (CDBAA) Tribromoacetic acid (TBAA)
TTHM	Trihalomethanes: Bromodichloromethane (BDCM) Bromoform (CHBr3) Chloroform (CHCl3) Dibromochloromethane (DBCM)

Table C.2 lists the approved laboratory analytical methods for TTHM and HAA5 along with guidelines for sample collection and storage. These guidelines include type of sample container, preservative and dechlorinating agents, pH, and sample collection.

Table C.2 Sampling Requirements of TTHM and HAA5 Analyses

<table>
<tr><th>Analyte Group</th><th>Analytical Method</th><th>Sample Container Material[2]</th><th>Preservative/Dechlorinating Agent (Recommended amount)</th><th>Storage Guidelines</th><th>Sample Collection Guidelines</th></tr>
<tr><td rowspan="3">TTHM</td><td>EPA 502.2</td><td>40 ml -120 ml screw cap glass vials with PTFE-faced silicone septum</td><td rowspan="2">Options:
(1) 3 mg $Na_2S_2O_3$/40 mL sample or
(2) 3 mg $Na_2S_2O_3$/40 mL sample and immediate acidification using HCl to pH < 2 or
(3) 25 mg ascorbic acid/40 mL sample and immediate acidification using HCl to pH < 2.
Option 1 may be used if THMs are the only compounds being determined in the sample. Options 2 & 3 require the sample to be dechlorinated prior to the addition of acid.</td><td rowspan="7">Keep at 4°C.

14 days maximum hold time[3].</td><td rowspan="7">Fill bottle to just overflowing but do not flush out preservatives.

No air bubbles.

Do not overfill.

Seal sample vials with no head space.

If ascorbic acid is used to dechlorinate TTHM samples, then the samples MUST be acidified. Acidification of TTHM samples containing $Na_2S_2O_3$ is required if the samples will also be analyzed for VOCs. In both cases, the pH must be adjusted at the time of sample collection, not later at the laboratory.</td></tr>
<tr><td>EPA 524.2</td><td>40 ml -120 ml screw cap glass vials with Teflon-faced silicone septum</td></tr>
<tr><td>EPA 551.1</td><td>60 ml screw cap glass vials with PTFE-faced silicone septum</td><td>1 g phosphate buffer & NH_4Cl or Na_2SO_3 mixture per 60 mL sample (mixture consists of 1 part Na_2HPO_4, 99 parts KH_2PO_4, and 0.6 parts NH_4Cl or Na_2SO_3. 1g per 60 mL results in a pH of 4.5-5.5 and 0.1 mg NH_4Cl or Na_2SO_3 per mL of sample.)</td></tr>
<tr><td rowspan="4">HAA5</td><td>EPA 552.1</td><td>250 ml (approx.) amber glass bottles fitted with Teflon-lined screw caps</td><td rowspan="3">0.1 mg NH_4Cl per mL of sample</td></tr>
<tr><td>EPA 552.2</td><td>50 ml (approx.) amber glass bottles fitted with Teflon-lined screw caps</td></tr>
<tr><td>EPA 552.3[4]</td><td>50 ml (approx.) amber glass bottles fitted with Teflon-lined screw caps</td></tr>
<tr><td>SM 6251 B</td><td>40 ml or 60 ml screw cap glass</td><td>65 mg NH_4Cl</td></tr>
</table>

[1] (40 CFR 141.131 (b))

[2] Selection of container should be coordinated with the laboratory.

[3] The holding time has been changed to 14 days for all HAA5 samples as a part of the Stage 2 DBPR.

[4] EPA Method 552.3 has been added as an approved HAA5 method as part of the Stage 2 DBPR.

C.2.1 Sampling Procedure

It is important to follow sampling procedures provided by your certified laboratory. Sampling procedures may vary slightly among individual laboratories; you should contact your laboratory to learn their procedures. The following is common procedure for collecting samples for TTHM and HAA5 analyses.

You will need:

1) Sample vials provided by laboratory (most laboratories will provide sample vials with proper preservative and dechlorinating agents)

2) Small bottle of 1:1 hydrochloric acid and eye dropper or pasteur pippettes (pH adjustment is necessary for some TTHM methods)

3) Water proof labels and permanent (indelible ink) marker

4) Ice/coolant and cooler

Procedure:

1) Label each sample vial. Use waterproof labels and indelible ink. Each label should include:

    - Unique sample ID
    - System name
    - Sample location
    - Sample date and time
    - Analysis required, if not already on label

2) Remove the aerator from the tap, if there is one present.

3) Open the water tap and allow the system to flush until the water temperature has stabilized (usually about 3-5 minutes). The purpose of this step is to ensure the sample does not represent stagnant water that has sat for a long time in the water line between the street and the faucet. The sample should be representative of the water flowing through the distribution system at the chosen sampling point.

4) Adjust the flow so that no air bubbles are visually detected in the flowing stream.

5) Slowly fill the sample vial almost to the top without overflowing. Use the bottle cap to add a small amount of additional sample water while simultaneously capping the vial to achieve a headspace-free sample. Be careful not to rinse out any of the preservative/dechlorinating agent during this process. After the bottle is filled, invert three or four times.

6) If collecting TTHM samples that require acidification, let the sample set for about 1 minute, allowing the dechlorinating chemical to take effect. Carefully open the vial and adjust the pH of TTHM sample to < 2 by adding approximately 4 drops of hydrochloric acid for every 40 mL of sample (amount of acid needed will depend on buffering capacity of sample). Recap the vial, and invert three or four times.

7) Invert the vial and tap it to check for air bubbles. If bubbles are detected, carefully open the vial and add more sample water using the cap to achieve a headspace-free sample.

8) Immediately cool the samples to 4°C by placing them in a cooler with frozen refrigerant packs or ice, or in a refrigerator. Samples should be maintained at this temperature during shipping to the laboratory.

9) Complete the Sample Chain of Custody provided by the laboratory and include it with the sample shipment.

C.2.2 Regarding Loss of Samples

Samples may be "lost" due to a number of reasons:

- Bottle broken during shipment from the water system to the laboratory
- Sample improperly collected (e.g., sample bottle not completely filled)
- Sample improperly shipped (e.g., not kept cold during shipment)
- Sample improperly preserved (e.g., not dechlorinated)
- Bottle is broken or lost at the laboratory
- Quality control doesn't meet method specifications when sample is analyzed

Resampling for the lost sample should be conducted as soon as possible after the loss is determined. Only the lost sample needs to be recollected, not the entire sample set that was collected together. Make sure to note the loss of sample and resample date as a deviation in your IDSE report.

C.3 Analytical Method Descriptions

The following are brief summaries of the approved TTHM and HAA5 methods.

C.3.1 EPA Method 502.2

Highly volatile organic compounds with low water solubility are extracted (purged) from the sample matrix by bubbling an inert gas through a 5 mL aqueous sample. Purged sample components are trapped in a tube containing suitable sorbent materials. When purging is complete, the sorbent tube is heated and back flushed with helium to thermally desorb trapped sample components onto a capillary gas chromatography (GC) column. The column is temperature programmed to separate the method analytes which are then detected with a photoionization detector (PID) and an electrolytic conductivity detector (ELCD) placed in series. Analytes are quantitated by procedural standard calibration. The PID is not required, if only TTHMs are being determined.

Identifications are made by comparison of the retention times of unknown peaks to the retention times of standards analyzed under the same conditions used for samples. Additional confirmatory information can be gained by comparing the relative response from the two detectors. For absolute confirmation, a gas chromatography/mass spectrometry (GC/MS) determination according to USEPA Method 524.2.

Highly volatile compounds with low water solubility, including TTHMs, are extracted from the water sample by bubbling an inert gas through 5 mL of the sample. The chemical compounds that are extracted from the water sample are then trapped in a tube that contains material to which the chemicals attach, or sorb. Once the extraction process has been completed, the tube containing the extracted chemicals is treated with helium, and the mixture of helium and chemicals enters a capillary gas chromatography (GC) column. The column is temperature programmed to separate the chemicals extracted from the water, which are then detected with a photoionization detector (PID) and an electrolytic conductivity detector (ELCD) placed in series. The amount of each chemical is determined using procedural standard calibration. The PID is not required if only TTHMs are being measured.

Chemical compounds are identified by comparing the retention times of unknown GC peaks with retention times for chemical standards analyzed under the same conditions. Confirmation can be made by comparing the relative response from the two detectors. For absolute confirmation of results, a gas chromatography/mass spectrometry (GC/MS) determination can be made using U.S. EPA Method 524.2.

For a complete description of this method see EPA publication: EPA/600/R-95/131 *Methods for the Determination of Organic Compounds in Drinking Water: Supplement III*.

C.3.2 EPA Method 524.2

Volatile organic compounds, including TTHMs, are extracted from the water sample by bubbling an inert gas through the sample. Extracted compounds are trapped in a tube that contains material to which the chemicals attach, or sorb. When the extraction process is complete, the tube is heated and flushed with helium to de-sorb the trapped chemicals into a capillary gas chromatography (GC) column interfaced with a mass spectrometer (MS). The GC column is temperature programmed to allow for the separation of different chemicals, which are then detected with the MS. Compounds detected by the GC are identified by comparing their measured mass spectra and retention times with reference mass spectra and retention times in a database. Reference mass spectra and retention times for different compounds are obtained by measuring calibration standards under the same conditions that are used for the water samples. The concentration of each compound is measured by comparing the MS response of the compound with the MS response of another compound used as an internal standard. Surrogate chemicals, whose concentrations are known in every sample, are measured using the same internal standard calibration procedure.

For a complete description of this method see EPA publication: EPA/600/R-95/131 *Methods for the Determination of Organic Compounds in Drinking Water: Supplement III*.

C.3.3 EPA Method 551.1

A 50 mL volume of the sample is extracted using either 3 mL of methyl-tert-butyl ether (MTBE) or 5 mL of pentane. A small sub-sample of the extract (2 µL) is then injected into a GC equipped with a fused silica column for separation, and a linearized electron capture detector for analysis. Concentrations of different chemical compounds are determined by comparing their measured amounts to standard calibration curves.

A typical sample can be extracted and analyzed using this method in 50 minutes for chlorinated byproducts (e.g., HAA5) and chlorinated solvents, and in two hours for all of the compounds analyzed by this method. Results can be confirmed by using a second, different GC column, by using primary confirmation columns installed in a single injection port, or by a separate confirmation analysis.

For a complete description of this method see EPA publication: EPA/600/R-95/131 *Methods for the Determination of Organic Compounds in Drinking Water: Supplement III*.

C.3.4 EPA Method 552.1

A 100 mL volume of the sample is adjusted to pH 5.0 and extracted using a pre-conditioned miniature anion exchange column. The chemical compounds to be analyzed are first eluted using small amounts of acidic methanol, and are then esterified directly in this medium after adding a small volume of methyl-tert-butyl ether (MTBE) as a co-solvent. The methyl esters are partitioned into the MTBE phase, and are identified and measured using capillary column gas chromatography with an electron capture detector (GC/ECD).

For a complete description of this method see EPA publication: EPA/600/R-92/129 *Methods for the Determination of Organic Compounds in Drinking Water: Supplement II.*

C.3.5 EPA Method 552.2

The pH of a 40 mL volume of sample is adjusted to less than 0.5, and the sample is extracted using 4 mL of methyl-tert-butyl ether (MTBE). The haloacetic acids that have been partitioned are then converted to their methyl esters by adding acidic methanol and heating them slightly. The acidic extract is then returned to neutral pH using a saturated solution of sodium bicarbonate. The chemical compounds of interest are identified and measured using capillary column gas chromatography with an electron capture detector (GC/ECD). Chemical concentrations are determined using standard calibration procedures.

For a complete description of this method see EPA publication: EPA/600/R-95/131 *Methods for the Determination of Organic Compounds in Drinking Water: Supplement III*.

C.3.6 EPA Method 552.3

[to be developed]

C.3.7 Standard Method 6251 B

The sample is extracted using methyl-tert-butyl ether (MTBE) at an acidic pH. A salting agent is added during the extraction process to increase the extraction's efficiency. Once extracted, compounds are methylated using diazomethane solution to produce methyl ester or other ether derivatives that can be separated in a gas chromatograph. A gas chromatograph equipped with a fused silica capillary column and an electron capture detector (GC/ECD) is used for analysis. Alternative detectors can be used if quality control criteria are met. Calibration standards are extracted, methylated, and analyzed in the same manner as the water samples to compensate for less than 100% recoveries during sample preparation.

For a complete description of this method see *Standard Methods for the Examination of Water and Wastewater: 21st Edition* published jointly by the APHA, AWWA, and WEF.

Appendix D

Simulated Distribution System Test

This page intentionally left blank.

D.1 Introduction

An SDS test involves storing a sample of disinfected finished water in a manner that reflects the conditions (pH, temperature, and residence time) of the distribution system. The purpose of an SDS test is to evaluate the potential of the finished water to form TTHM and HAA5 in the distribution system conditions at different residence times. An SDS test is site-specific and therefore, there is no universal set of conditions that applies to all systems.

Section D.2 provides the recommended procedure for conducting an SDS laboratory test. Section D.3 describes how SDS tests can be used in conjunction with Stage 1 DBPR and other DBP monitoring data to estimate average and maximum residence times.

D.2 Recommended SDS Test Procedure

A separate SDS sample should be collected for each distribution system residence time to be evaluated. The following protocol is recommended for collecting, storing, and analyzing an SDS sample:

Test Conditions

- The pH of the sample should be that of the distribution system water (± 0.2). No pH adjustments should be made after collecting the finished water samples for any of the SDS tests.

- The sample should be held at a temperature comparable to the distribution system temperature between the treatment plant and the TTHM sampling points in the distribution system for the corresponding time period. The goal should be a temperature within ± 2°C of either the water entering the distribution system or the water at the DBP sampling point being evaluated. If major temperature fluctuations occur in the distribution system during the SDS tests, these should be taken into account when analyzing the data.

- The holding time of an SDS test begins when an SDS sample is collected, and ends when the sample is transferred into sample bottles (with appropriate preserving and dechlorinating agents) for TTHM and HAA5 analysis. The total reaction time actually begins with the addition of chlorine-based oxidants at the treatment plant.

- A disinfectant residual should be present at the end of the holding time.

Sample Collection

- SDS samples should be collected at the entry point to the distribution system, after the final addition of chlorine and/or ammonia or any chemicals added for corrosion control or pH adjustment are completely mixed in treated water. (In cases where systems use chloramines for secondary disinfection, SDS sample collection will typically be at the location where the system measures free ammonia to control the dosing of ammonia). *If systems employ booster disinfection, then a second SDS sample collected after booster disinfectant addition and a separate SDS analysis are recommended.*

- SDS samples should be collected in 250 mL amber glass bottles (or larger) with TFE-lined screw caps, and should be collected head space-free, with no addition of any preservatives or dechlorinating agents. (The sample should be of sufficient volume for all the analyses needed for SDS sample analyses, i.e., DBPs, disinfectant residual, pH, etc.) Prior to collecting the samples, the bottles should be pre-treated with concentrated chlorine solution and copiously rinsed with deionized water, then oven dried at 180 ˚C for an hour, to ensure that the glassware is chlorine demand free.

Holding Time

The holding time represents a residence time pre-determined by the system. The system could conduct several SDS tests at a range of residence times to develop a kinetic curve (see section D.3). The system could also use estimated residence times of DBP sampling sites in the distribution system and compare the SDS results to its DBP results.

Sample Storage

The bottle containing an SDS sample is best stored in the treatment plant where it is collected.

- It can be suspended in the plant clearwell to maintain it at the finished water temperature, or in a container in a sink with a constant flow of finished or distributed water running through the container.

- The collected sample may be transported to an off-site laboratory, provided it is maintained at the desired storage temperature during transport and for the duration of the test. During the holding time at the laboratory, an SDS sample can be placed in an incubator (set at the selected distribution system temperature ± 2 ˚C) or in a container in a sink with a constant flow of finished or distributed water running through the container (if the laboratory receives water from the same distribution system being tested).

Sample Analysis

At the end of a specified residence time, an SDS sample is analyzed for several parameters (disinfectant residual, TTHM, and HAA5, pH, temperature).

- The SDS sample should be divided by pouring it into sample bottles containing the appropriate dechlorinating agents/preservatives for each analysis. The TTHM sample bottle should be filled first, followed by the HAA5 sample bottle. Care must be taken to not aerate the sample during this splitting process, in order to prevent the loss of volatile THMs.

- Immediately after the TTHM and HAA5 sample bottles are filled, the pH, temperature, and disinfectant residual concentration should be determined in the remaining aliquot of the SDS sample. If no disinfectant residual is detected, then the result of this SDS test should be thrown out.

- The TTHM and HAA5 samples should be analyzed within the holding time specified by the method.

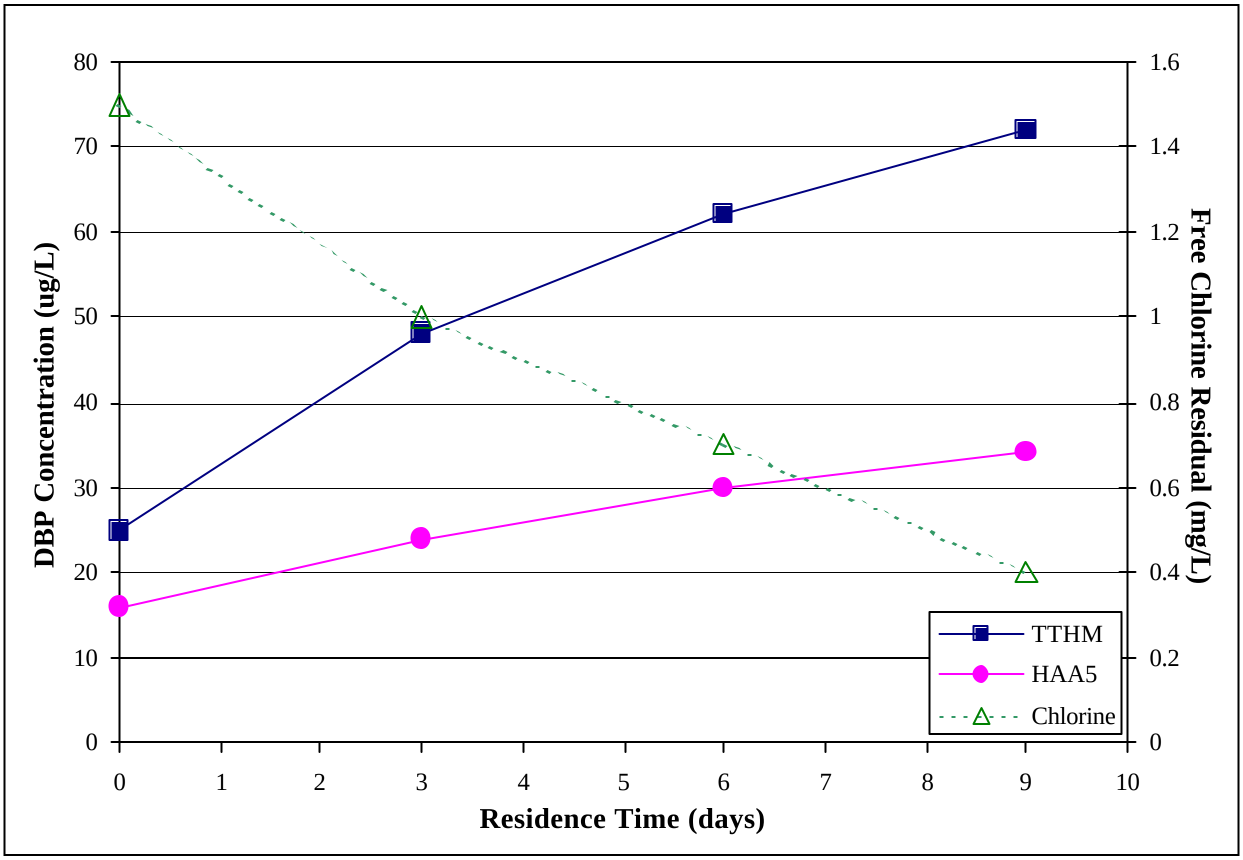
- The TTHM and HAA5 analyses should be conducted by a laboratory certified under the drinking water certification program to perform those analyses. Appendix C describes TTHM and HAA5 laboratory analyses.

D.3 Using SDS Tests to Determine Average and Maximum Residence Time

For systems that do not have good information about their residence time, a number of SDS tests can be conducted and compared to Stage 1 compliance monitoring data to help estimate average and maximum residence time. It should be noted that the SDS tests should be conducted in conjunction (preferably done on the same day or a couple of days before) with the Stage 1 DBP compliance monitoring sampling.

Because DBP formation is not linear, it is recommended that a kinetic curve be developed to describe the system specific DBP formation. To create a useful curve, a minimum of four SDS samples should be collected at the finished water sampling location. Analysis should begin immediately for the first sample (aliquots should be transferred to sample vials with appropriate preservation and dechlorinating agents for TTHM and HAA5 anlaysis, and chlorine residual, pH, and temperature should be analyzed immediately thereafter). This represents time zero. A second sample should be stored at the finished or distribution system temperature (see section D.2 for details) for an estimated maximum distribution system residence time (this selected time interval will be a best guess estimate). The other two SDS samples are stored for two intermediate time intervals that equally subdivide the maximum residence time (e.g., if you estimate that your maximum residence time is 6 days, store your other two SDS samples for 2 days and 4 days). At the end of the selected storage times, transfer the sample aliquots to appropriate TTHM and HAA5 sample bottles (with preservation and dechlorinating agents) for analysis. Plot the the resultant TTHM and HAA5 data (µg/L) on the y-axis and corresponding holding times (days) on the x-axis. An example kinetic curve with disinfectant residual data is presented in Figure D.1.

Figure D.1 SDS Test Kinetic Curve



To estimate the residence time of monitoring sites in the distribution system, use the DBP results from the monitoring sites and the kinetic curve developed from the SDS tests. For example, the TTHM result from a Stage 1 compliance monitoring sample was 40 µg/L. Using Figure D.1, 40 µg/L of TTHM corresponds to a residence time of 2 days. Combining these data with disinfectant residual data from each of the four SDS samples may also be useful.

When designing SDS studies, systems using booster disinfection must consider the application of disinfectants in the distribution system. For systems that employ booster chlorination in the distribution system, another SDS sample should be taken after the re-chlorination station and the residence time should simulate the distribution system conditions downstream of the re-chlorination station.

Appendix E

IDSE SMP Report for Producing Surface Water Systems Serving $\geq$ 10,000 People

This appendix is provided as an example IDSE report for producing surface water systems serving at least 10,000 people and opting to complete the Standard Monitoring Program (SMP).

Chapter 5 presents the detailed SMP requirements for these systems, and Chapter 8 provides guidance on selecting SMP sites and Stage 2B compliance monitoring sites based on SMP results. Chapter 8 also presents the IDSE reporting requirements. The application of the basic guidance on SMP site selection and Stage 2B compliance monitoring site selection is shown in this example, along with several instances of the use of best professional judgement being applied.

The italicized text within the appendix consists of comments and explanations and is not intended to represent the recommended content of an actual IDSE Report.

This page intentionally left blank.

Initial Distribution System Evaluation Report for Elm City

PWSID Number: US1111111

Address: 1234 Main Street
Elm City, US 99999

Contact Person: Mr. Ronald Doe, P.E.

Phone Number: 123-555-0000

Fax Number: 123-555-0001

Email Address: Rdoe@ci.elmcity.us

System Type: Community, surface water

Population Served: 160,000

This page intentionally left blank.

I. SMP PLAN

1. System Description:

This section of the report should include a summary of typical system operating characteristics (and how they change on a seasonal basis if appropriate) explaining how sources are used to meet system demands, where high water age is expected to occur, and any special aspects of operation that could affect DBP concentrations in the distribution system. Information about water treatment processes and source water quality data should also be in this section, including a brief description of the water treatment process train.

General system characteristics:

Service area: Elm City plus surrounding suburban areas
Production: Annual average daily production = 15 MGD

Source Water Information:

Hardwood Lake (surface water)
- pH: from 6.9 to 7.5
- Alkalinity: from 82 to 98 mg/L as $CaCO_3$
- TOC: from 2.1 to 4.0 mg/L as C

Softwood River (surface water)
- pH: from 6.8 to 7.9
- Alkalinity: from 77 to 94 mg/L as $CaCO_3$
- TOC: from 1.6 to 4.4 mg/L as C

Entry points and service areas under the influence of each entry point:
(Entry points should be tied to source(s) and typical flows noted)

Entry points:	Hardwood Plant:	Design Capacity = 20 mgd
		Average Daily Production = 7.5 mgd
	Softwood River Plant:	Design Capacity = 20 mgd
		Average Daily Production = 7.5 mgd

Customers located in the Industrial Park area, Oakville, Pineville, and south downtown areas generally receive water from the Hardwood Plant

Customers located in the Cypressville, Cedarville, Poplarville, and north downtown areas generally receive water from the Softwood Plant

Customers located in the Weeping Willow Community, Appleville, and central downtown areas generally receive a mixture of water from both plants

Treatment Provided:

Hardwood – ferric chloride coagulation, flocculation, sedimentation, dual-media filtration
Softwood River – ferric chloride coagulation, flocculation, sedimentation, dual-media filtration, followed by GAC
Primary and residual disinfection: Chlorine/chlorine at both plants

Description of distribution system:

Distribution system (estimated length of lines and range of diameter):
About 400 miles, 4" - 56" (approximately 6 MG total pipe volume)

5 storage tanks of 10 MG total capacity
1 ground tank 4 MG capacity
4 elevated tanks 6 MG capacity

Following recent customer complaints in areas downstream of the Cherry Hill tank, the city evaluated mixing conditions in each distribution system tank. As a result, the city made some inlet/outlet modifications at both the Cherry Hill and Apple Drive tanks to improve tank mixing.

The average residence time of water in the distribution system is six to eight days.

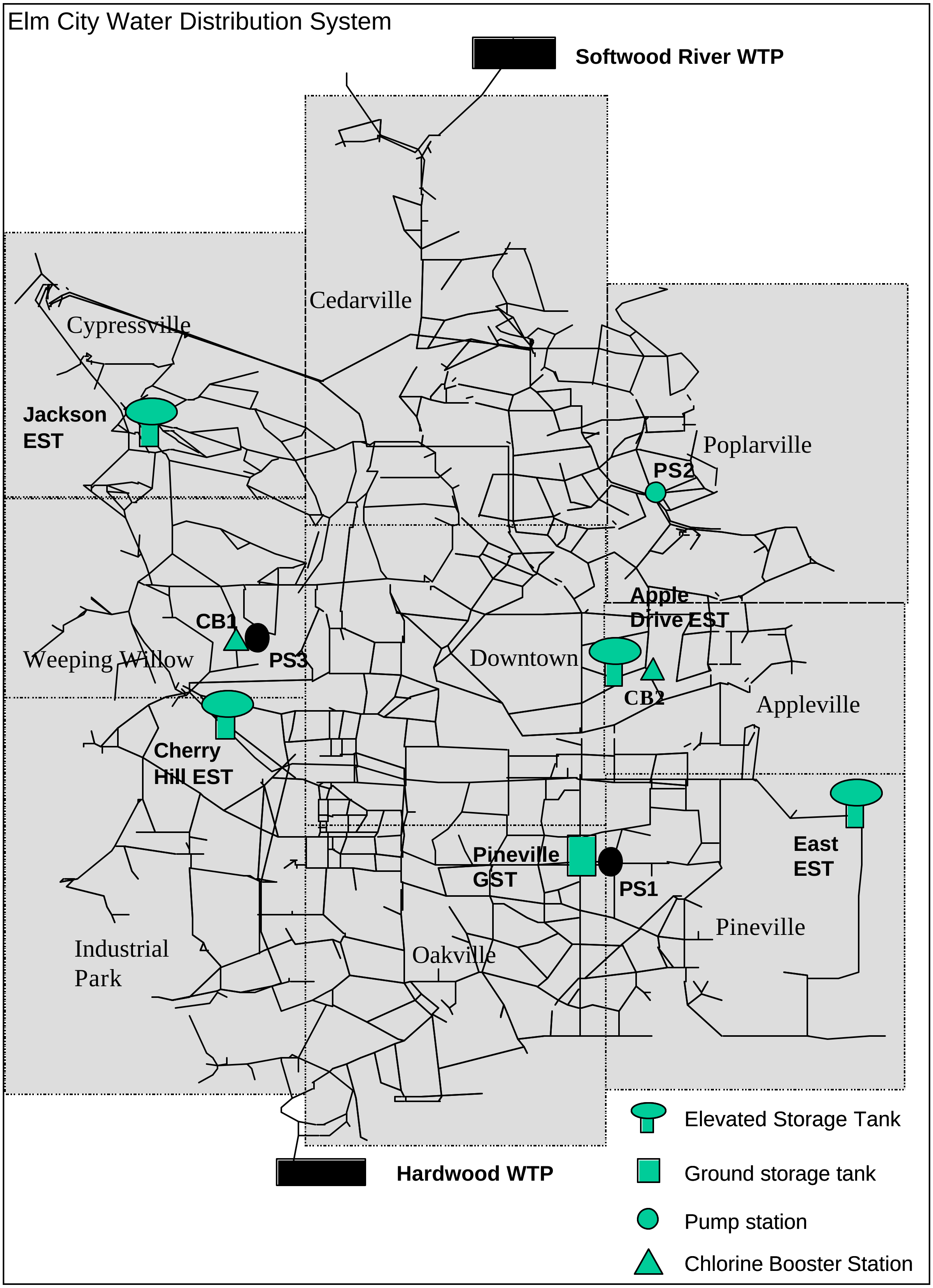
Pump stations:
Station #1 is located at the ground storage tank (in Pineville). This pump is primarily used during peak demands and low pressure situations. The pump is timed to turn on in the morning and evening during peak demand and when the pressure drops below 40 psi at a point downstream of the pump station.

Stations #2 and #3. These pumps are used to boost system pressure when the pressure in the areas downstream of these pumps (Weeping Willow and Poplarville) drops below 40 psi.

Booster chlorination facilities:
Facility #1 is located on Cherry Hill Ave. (downstream of the Cherry Hill storage tank at pump station #3). This facility is occasionally used during the summer when remote locations downstream of the booster chlorination facility lose residual.

Facility #2 is located at the intersection of Second Ave. and 11th St. (in a mixing zone) in an area of the distribution system where chlorine residuals are frequently low.

2. Schematic of the distribution system:



3. SMP monitoring requirements:

The Elm City system serves approximately 160,000 people and has two surface water plants. Therefore, a total of 16 SMP sample sites (8 per plant) are required to be sampled approximately every 60 days for one year (6 dual sample sets per site) for TTHM and HAA5. Because it uses chlorine as a disinfectant in the distribution system, three sites representative of high TTHM are required, but only one site near the entry point is required.

Required SMP Sample Sites

SMP Site Type	Number of Sites in the Hardwood Plant Influence Zone	Number of Sites in the Softwood River Plant Influence Zone
Near entry to the distribution system	1	1
Average residence time	2	2
Representative of high TTHM	3	3
Representative of high HAA5	2	2

Available Data:

Report all data that helped in sample site selection. If you have bromide, TOC, or HPC data, these may be helpful for justifying Stage 2B site selection. For this example, only tables with limited data are presented for Stage 1 DBPR sample sites and the sites chosen as SMP sample sites. Your report should include data for all sites that were considered for SMP sites.

Chlorine residual and HPC data were available for Total Coliform Rule sample sites and the 8 Stage 1 DBPR sample sites. The chlorine data for the summer months of June, July, August, and September were reviewed, and monthly averages and an overall average were calculated. Table E.1 presents these data and shows which sites were chosen as SMP sites.

Quarterly HPC data was also available for the same year and at the same sites as the free chlorine data. The four results for each site were averaged. The quarterly results and yearly average values are presented in Table E.2. The results are ordered based on the Stage 1 DBPR and SMP site numbers.

Table E.1 Elm City Distribution System—Free Chlorine Residual (Cl_2) Data

Sample Site ID #	Source/ Plant	Stg. 1 Site Type	SMP Site #	SMP Site Type	Free Chlorine Residual (mg/L) June	July	Aug.	Sept.	Avg.
Stg. 1 #1	SRP	Avg.			0.6	0.9	1.1	0.8	0.9
Stg. 1 #2	SRP	Avg.			0.6	0.7	0.8	1.2	0.8
Stg. 1 #3	SRP	Avg.			0.3	0.6	0.3	0.2	0.4
Stg. 1 #4	SRP	Max.			0.2	0.3	0.5	0.3	0.6
Stg. 1 #5	HP	Avg.			0.9	0.7	1.0	1.2	1.0
Stg. 1 #6	HP	Avg.			0.2	0.8	0.8	0.5	0.6
Stg. 1 #7	HP	Avg.			0.8	0.9	0.3	0.8	0.7
Stg. 1 #8	HP	Max.			0.2	1.0	0.7	0.1	0.6
TCR #5	HP		1	E	1.6	1.4	1.6	1.5	1.5
TCR #4	HP		2	A	0.8	0.6	0.9	0.8	0.8
TCR #15	HP		3	A	0.6	0.4	0.4	0.4	0.5
TCR #16	HP		4	H	0.6	0.2	0.5	0.4	0.4
TCR #8	HP		5	H	0.4	0.3	0.3	0.5	0.4
TCR #2	HP		6	T	0.3	0.4	0.2	0.2	0.3
TCR #9	HP		7	T	0.3	0.2	0.2	0.4	0.3
TCR #12	HP		8	T	ND	0.1	0.1	0.3	0.1
TCR #10	SRP		9	E	1.4	1.2	0.9	1.7	1.3
TCR #11	SRP		10	A	0.6	0.6	0.5	0.9	0.7
TCR #13	SRP		11	A	0.5	0.3	0.4	0.5	0.6
TCR #6	Mix/SRP		12	H	0.7	0.4	0.8	1.0	0.7
TCR #1	SRP		13	H	0.5	0.8	0.9	0.4	0.7
TCR #7	Mix/SRP		14	T	0.3	0.4	0.7	0.6	0.5
TCR #3	SRP		15	T	0.2	0.6	0.3	0.2	0.3
TCR #14	Mix/SRP		16	T	0.6	0.7	0.6	0.6	0.6
Distribution System Warm Months Average									**0.6**

Mix - Mixing Zone
HP - Hardwood Plant
SRP - Softwood River Plant
TCR - Total Coliform Rule
Stg. 1 - Stage 1 DBPR
ND - Non-Detection
E - Near Entry Point
A - Average Residence Time
T - Representative High TTHM
H - Representative High HAA5

Table E.2 Elm City Distribution System—Heterotrophic Plate Counts (HPC) Data

Sample Site ID #	Source/ Plant	Stg. 1 Site Type	SMP Site #	SMP Site Type	HPC (cfu/mL)				
					4th Qtr.	1st Qtr.	2nd Qtr.	3rd Qtr.	Avg.
Stg. 1 #1	SRP	Avg.			56	42	276	345	180
Stg. 1 #2	SRP	Avg.			82	136	246	146	152
Stg. 1 #3	SRP	Avg			140	215	615	557	382
Stg. 1 #4	SRP	Max			280	163	263	446	288
Stg. 1 #5	HP	Avg.			140	66	236	364	201
Stg. 1 #6	HP	Avg.			50	42	222	223	134
Stg. 1 #7	HP	Avg			53	42	72	84	63
Stg. 1 #8	HP	Max			196	45	425	653	330
TCR #5	HP		1	E	12	8	12	34	17
TCR #4	HP		2	A	78	86	364	384	228
TCR #15	HP		3	A	35	62	92	147	84
TCR #16	HP		4	H	34	76	89	97	74
TCR #8	HP		5	H	68	43	57	79	62
TCR #2	HP		6	T	35	43	45	64	47
TCR #9	HP		7	T	156	278	359	169	240
TCR #12	HP		8	T	233	214	546	456	362
TCR #10	SRP		9	E	67	14	42	35	40
TCR #11	SRP		10	A	43	34	224	156	114
TCR #13	SRP		11	A	54	65	65	573	189
TCR #6	Mix/SRP		12	H	53	64	123	94	83
TCR #1	SRP		13	H	50	34	63	113	65
TCR #7	Mix/SRP		14	T	69	43	43	37	48
TCR #3	SRP		15	T	70	212	332	356	242
TCR #14	Mix/SRP		16	T	66	53	53	153	81

Mix - Mixing Zone
HP - Hardwood Plant
SRP - Softwood River Plant

TCR - Total Coliform Rule
Stg. 1 - Stage 1 DBPR

E - Near Entry Point
A - Average Residence Time
T - Representative High TTHM
H - Representative High HAA5

4. Summary of selected SMP sample sites:

Present the rationale for the selection of the SMP sample sites in your system, as well as a schematic showing their location within the distribution system.

Sample sites were chosen to represent diverse geographical areas of the distribution system. Each site is shown on the map of the distribution system in section I.6. Water quality data obtained from residual chlorine (Table E.1) and HPC (Table E.2) monitoring were considered in the selection of the SMP monitoring sites.

SMP Site #1 – Entry point to the distribution system for Hardwood Water Treatment Plant. This site is where the first group of customers receives water.

SMP Site #2 – Represents average residence time of water leaving the Hardwood Plant. Based on chlorine monitoring results at TCR sample sites, we identified the areas within the system where chlorine levels equaled approximately 50 percent of the initial residual concentration at the high service pumps and chose this site from within those areas. There are no storage facilities between the treatment plant and this site.

SMP Site #3 – Represents average residence time of water leaving the Hardwood Plant. Water at this site does not go through a storage facility, but the chlorine residual is generally 35 to 40 percent of the Hardwood Plant finished water concentration. We attribute this loss of chlorine to the fact that the transmission and distribution lines serving this area are older unlined cast iron and have been observed to show significant build-up of corrosion by-products (tubercles). We believe that these corrosion by-products exert a chlorine demand that results in lower than typical chlorine residual at this site, although we believe it has a lower average water age than SMP #2.

SMP Site #4 – Represents high HAA5 levels. Sample site is in an area approaching the perimeter of the distribution system. Water in this area is primarily from the Hardwood Plant. Chlorine residual at this site ranges between 0.2 and 0.6 mg/L, and the heterotrophic plate count is consistently below 100 cfu per mL year round.

SMP Site #5 – Represents high HAA5 levels. We have over 7 years of data from this site. Water at this site is from the Hardwood Plant. Chlorine residual levels are between 0.3 and 0.5 mg/L, and heterotrophic plate count is below 100 cfu/mL.

SMP Site #6 – Represents high TTHM levels. This sampling site is believed to receive water from a 4 MG ground tank located in the Appleville region of the distribution system during high demand periods and is at the entrance to a small subdivision cul-de-sac in the Oakville community. This site is near the predicted edge of the mixing zone, and chlorine residuals at this site are generally very low, indicating this may be a hydraulic dead end. The sample site is near the first house on the cul-de-sac (which has 12 homes total).

<u>SMP Site #7</u> – Represents high TTHM levels. This site is near the edge of the mixing zone between the Softwood River and Hardwood plant influence areas, but within the an area of the system believed to receive all of its water from the Hardwood Plant. Chlorine residual levels ranged between 0.2 and 0.4 mg/L at this site.

<u>SMP Site #8</u> – Represents high TTHM levels. This site has been problematic in the past due to positive total coliform test results, non-detectable chlorine residuals, high heterotrophic plate count results, and odor complaints. A 4-inch blow-off was installed downstream of this site, but it continues to have periodic poor water quality. Water in this area is from the Hardwood Plant.

<u>SMP Site #9</u> – Entry point to the distribution system for the Softwood River Water Treatment Plant. This site is just after the high service pumps at the Water Treatment Plant.

<u>SMP Site #10</u> – Represents average residence time. Chlorine residual is generally 50 to 60 percent of the plant finished water concentration.

<u>SMP Site #11</u> – Represents average residence time. Water does not go through a storage facility but the chlorine residual is generally 35 to 40 percent of the plant finished water concentrations. The transmission and distribution lines serving this area are older unlined cast iron with build-up of corrosion by-products (tubercles) in several areas. We believe these corrosion by-products exert a chlorine demand, lowering chlorine residual, even though residence time is less than in areas with similar chlorine residual concentrations.

<u>SMP Site #12</u> – Represents high HAA5 levels. At this site, the water age is believed to be greater than average because it is within the mixing zone, but the chlorine residual is never below 0.4 mg/L and the heterotrophic count plate is usually low (below 100 cfu/mL).

<u>SMP Site #13</u> – Represents high HAA5 levels. Our Stage 1 DBPR monitoring results indicate that the high HAA5 concentrations move around our system depending on the season and production of the Hardwood and Softwood River Plants, especially in the areas served by the Softwood River Plant.

<u>SMP Site #14</u> – Represents high TTHM levels. This sample site is located in a zone of the distribution system that has been recently developed. This connection is located downstream from a chlorine booster station. Chlorine residuals are normally in the 0.3 to 0.7 mg/L range. Water in this area is generally a mix of water from the Hardwood and Softwood River Plants.

<u>SMP Site #15</u> – Represents high TTHM levels. This site is downstream from the Cypressville Storage Tank, a 1.5 million gallon elevated storage tank. There are often low chlorine residuals in the areas downstream of this tank.

<u>SMP Site #16</u> – Represents high TTHM levels. This sampling site is in the mixed zone before the last group of connections near the end of the distribution system. This area receives water from the

Jackson Storage Tank and water that bypasses the tank. Water from this area can vary greatly in the percentages of Softwood River and Hardwood Plant water.

5. SMP Sample Schedule:

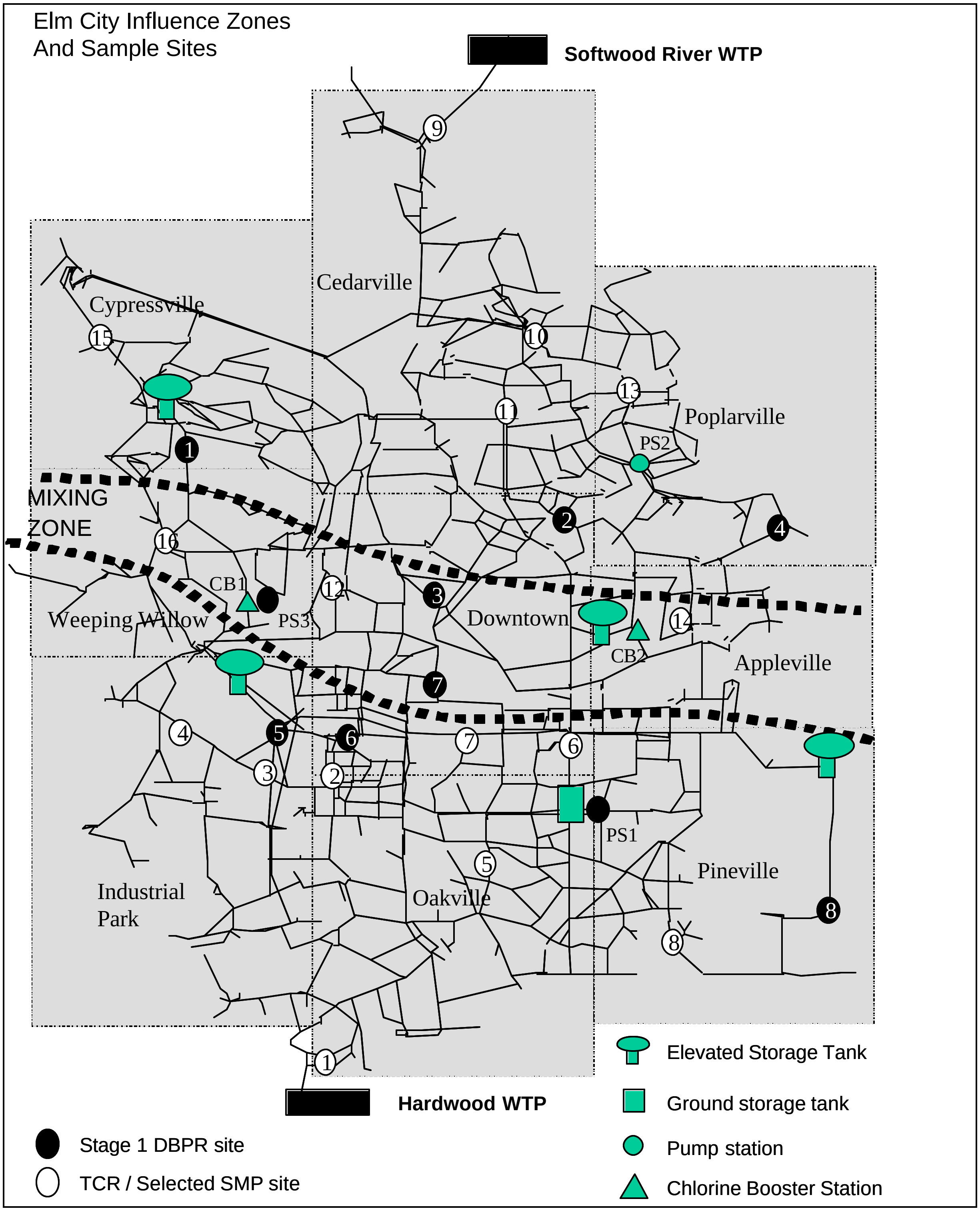
Because the quarterly Stage 1 DBPR monitoring is the only DBP monitoring that has been performed in the Elm City system, historic DBP data is available for only the months of January, April, July, and October. July has regularly had the highest DBP levels, but no DBP data is available for the other summer months. As a result, we also reviewed finished water temperature from two years of TCR sampling records and determined that our peak month for distribution system water temperature is August. However, we also found that July's average distribution system water temperature for the two years reviewed was only 0.5º C less than August's. Based on the historic DBP data and minimal difference in average water temperature, we concluded that July is the controlling month for the Elm City distribution system. The following table summarizes our planned SMP sample dates and is based on collection of our samples on the second Monday of the month.

Proposed SMP Sample Schedule

Planned Sample Date
November 8, 2005
January 10, 2006
March 7, 2006
May 9, 2006
July 11, 2006
September 12, 2006

Dual sample sets will be collected from each of the 16 SMP sample sites on or close to the listed dates and analyzed for TTHM and HAA5 by a State-certified laboratory.

6. Map of the distribution system showing major transmission mains, numbered Stage 1 DBPR compliance sites, and numbered SMP sample sites:



II. SMP RESULTS

1. Introduction:.

The SMP was conducted between November 2004 and September 2005. The following table summarizes our planned SMP sample dates, the actual dates when samples were collected, and the reasons for deviations from the plan.

Actual SMP Sample Schedule

Planned Sample Date	Actual Sample Date	Explanation
November 8, 2005	November 8, 2005	On schedule.
January 10, 2006	January 10, 2006	On schedule.
March 7, 2006	March 11, 2006	Major snowstorm created hazardous road conditions and limited access to sample sites
May 9, 2006	May 9, 2006	On schedule.
July 11, 2006	July 11, 2006	On schedule.
September 12, 2006	September 12, 2006	On schedule

2. Summary of IDSE SMP and Stage 1 DBPR compliance data:

All DBP results from the SMP and concurrent Stage 1 DBPR compliance monitoring are presented in this section. Table E.3 presents the DBP results for the SMP sample sites, organized by plant, then in order of highest to lowest TTHM average. Table E.4 presents the DBP results for the Stage 1 DBPR compliance sample sites for the period from November 2004 to August 2005. Sites proposed as Stage 2B compliance sites are shaded within the tables.

Table E.3. Elm City—IDSE SMP Monitoring Results

SMP Site #	Plant	Site Type	TTHM (µg/L)		HAA5 (µg/L)	
			Data[1]	LRAA	Data[1]	LRAA
1	Hardwood	entry point	36, 42, 30, 25, 38, 28	33	50, 44, 43, 47, 48, 38	45
2	Hardwood	average residence time	54, 39, 42, 56, 60, 42	49	22, 29, 36, 40, 41, 30	33
3	Hardwood	average residence time	47, 40, 52, 43, 51, 41	46	20, 25, 25, 29, 27, 19	24
4	Hardwood	high HAA5	33, 29, 41, 42, 44, 22	35	36, 43, 52, 51, 48, 38	45
5	**Hardwood**	**high HAA5**	**35, 40, 41, 37 46, 43**	**40**	**60, 59, 64, 55, 66, 54**	**60**
6	Hardwood	high TTHM	62, 60, 60, 64, 68, 70	64	42, 40, 33, 38, 46, 30	38
7	Hardwood	high TTHM	68, 62, 54, 52, 72, 70	63	39, 45, 28, 33, 40, 32	36
8	**Hardwood**	**high TTHM**	**65, 61, 73, 71, 72, 64**	**68**	**41, 39, 46, 45, 39, 47**	**43**
9	Softwood River	entry point	40, 42, 49, 38, 38, 46	42	43, 47, 40, 48,	45
10	Softwood River	average residence time	42, 20, 58, 62, 62, 30	46	23, 56, 40, 52, 40, 28	40
11	Softwood River	average residence time	47, 50, 41, 54, 48, 40	47	14, 20, 21, 23, 29, 19	21
12	Mix/Softwood River	high HAA5	35, 29, 47, 37, 47, 27	37	36, 40, 46, 48, 40, 34	41
13	Softwood River	high HAA5	52, 35, 46, 42, 50, 38	44	56, 44, 65, 50, 50, 58	54
14	Mix/Softwood River	high TTHM	56, 50, 55, 51, 61, 45	53	42, 30, 43, 38, 34, 42	38
15	Softwood River	high TTHM	48, 56, 70, 52, 65, 49	57	28, 40, 33, 38, 34, 42	35
16	**Mix/Softwood River**	**high TTHM**	**72, 49, 68, 55, 69, 53**	**61**	**20, 21, 38, 28, 19, 35**	**27**

[1]Data obtained from sampling every 60 days are listed in order for November, January, March, May, July, and September (as required for a surface water supply ≥10,000).
Note: **Bold text and shading** identify proposed Stage 2 DBPR compliance sites.

Table E.4. Elm City—Stage 1 DBPR Compliance Monitoring Results

Site ID #	Plant	Site Type	TTHM (µg/L)		HAA5 (µg/L)	
			Data[1]	LRAA	Data[1]	LRAA
Stg. 1 #1	Softwood River	Average	45, 34, 56, 62	49	24, 32, 43, 45	36
Stg. 1 #2	**Softwood River**	**Average**	**36, 42, 45, 45**	**42**	**47, 50, 55, 56**	**52**
Stg. 1 #3	**Softwood River**	**Average**	**32, 34, 48, 67**	**45**	**50, 62, 64, 65**	**59**
Stg. 1 #4	**Softwood River**	**Maximum**	**64, 68, 83, 74**	**72**	**21, 25, 26, 28**	**25**
Stg. 1 #5	Hardwood	Average	44, 20, 62, 42	42	34, 45, 33, 41	38
Stg. 1 #6	Hardwood	Average	46, 49, 39, 50	46	22, 30, 39, 41	33
Stg. 1 #7	**Hardwood**	**Average**	**41, 22, 50, 59**	**43**	**4, 46, 64, 58**	**54**
Stg. 1 #8	**Hardwood**	**Maximum**	**65, 50, 60, 73**	**62**	**19, 22, 37, 30**	**27**

[1]Data listed in order for October, January, April, and July quarterly sampling.

Note: **Bold text and shading** identify proposed Stage 2B compliance sites.

III. PROPOSED STAGE 2B COMPLIANCE MONITORING SITES

1. Site Summary:

A total of eight Stage 2B compliance monitoring sites (four per plant) were selected from the Stage 1 DBPR and SMP sites, as shown in the previous tables and as summarized in the following table. A schematic of the monitoring sites is presented in section III.4.

Stage 2B Proposed Compliance Monitoring Sites

Stage 2B Compliance Sites			Previous Site ID #	
Site #	Source/ Plant	Type	SMP Site #	Stage 1 DBPR Site #
1	Softwood River	Average		Stg. 1 #3
2	Softwood River	High HAA5		Stg. 1 #2[1]
3	Softwood River	High TTHM	16	
4	Softwood River	High TTHM		Stg. 1 #4
5	Hardwood	Average		Stg. 1 # 7
6	Hardwood	High HAA5	5	
7	Hardwood	High TTHM	8	
8	Hardwood	High TTHM		Stg. 1 # 8

[1] This site was an average residence time site under Stage 1 DBPR, but represented high HAA5 concentrations in the distribution system.

2. Justification of Site Selections:

1. **Softwood River Plant Average Site –** Although Stage 1 DBPR site #1 had the highest TTHM LRAA of the Stage 1 average residence time sites, Stage 1 DBPR site #3 was chosen because the TTHM LRAAs at these two sites were similar, but the HAA5 LRAA at Stage 1 DBPR site #3 was considerably higher. Therefore, Stage 1 DBPR site #3 was chosen as Elm City's Stage 2B site #1.

2. **Softwood River Plant Representative High HAA5 Site –** Stage 1 DBPR site #2 and SMP site #13 had similar HAA5 LRAAs. However, Stage 1 site #2 was chosen as the Stage 2B #2 because we have multiple years of data at this site, and this will allow us to maintain an historical record at this site.

3. **Softwood River Plant Representative High TTHM Sites –** SMP site #16 and Stage 1 DBPR site # 4 were chosen as Elm City's Stage 2B sites #3 and #4, respectively, because they had the highest TTHM averages over the SMP sampling period among all Softwood River Plant sample sites.

4. **Hardwood Plant Average Site –** Stage 1 DBPR site #7 had the highest HAA5 LRAA for the SMP sampling period, much higher than the other two Stage 1 DBPR average residence time sites, and a TTHM LRAA that was second highest among the Stage 1 DBPR average residence time sites. Therefore, Stage 1 DBPR site # 7 was chosen as Elm City's Stage 2B site #5.

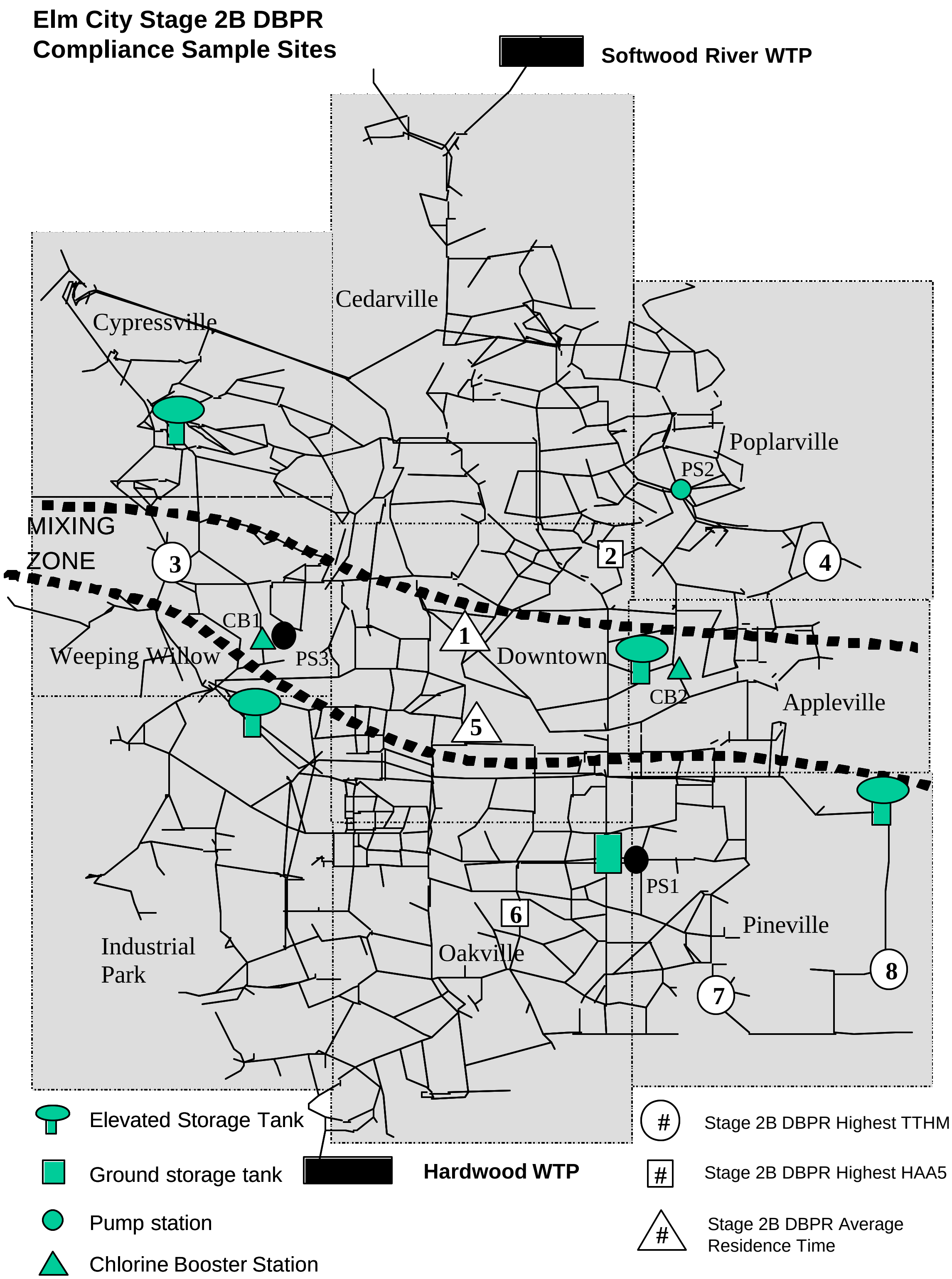
5. **Hardwood Plant Representative High HAA5 Site –** SMP site #5 was chosen as Elm City's Stage 2B site #6 because it has the highest HAA5 LRAA of all the Hardwood Plant sample sites.

6. **Hardwood Plant Representative High TTHM Sites –** SMP site #8 and Stage 1 DBPR site #8 were chosen as Elm City's Stage 2B sites #7 and #8, respectively. SMP site #8 was chosen because it had the highest TTHM LRAA of all the Hardwood Plant sample sites during the SMP period. Stage 1 DBPR site #8 was chosen for several reasons. It is in an area of the system not represented by other Stage 2B sites. It is downstream of a storage tank. It will provide historical continuity in DBP sampling. It had a single sample TTHM result higher than the highest single sample result of the two sites that had higher averages (73 vs. 72 and 70). It had a TTHM LRAA only slightly lower than the two SMP sites that had higher averages (62 vs. 63 and 64) and achieved this average with a warm weather sample being taken in only one month (July), versus the three warm weather samples (May, July, and September) taken at the SMP sites.

3. Proposed Stage 2B Compliance Monitoring Schedule

Stage 2B compliance monitoring will be scheduled for January, April, July, and October, the same as Stage 1 DBPR and Stage 2A DBPR sampling, for consistency and because the difference in distribution system water temperature between July and August is minimal (average 0.5º C higher in August, based on a review of 2 years of TCR sampling records).

4. Map of Proposed Stage 2B Compliance Monitoring Sites:



Appendix F

IDSE SMP Report for Producing Ground Water Systems Serving $\geq$ 10,000 People

This appendix is provided as an example IDSE report for producing ground water systems serving at least 10,000 people and opting to complete the Standard Monitoring Program (SMP).

Chapter 6 presents the detailed SMP requirements for these systems, and Chapter 8 provides guidance on selecting SMP sites and Stage 2B compliance monitoring sites based on SMP results. Chapter 8 also presents the IDSE reporting requirements. The application of the basic guidance on SMP site selection and Stage 2B compliance monitoring site selection is shown in this example, along with several instances of the use of best professional judgement being applied.

The italicized text within the appendix consists of comments and explanations and is not intended to represent the recommended content of an actual IDSE Report.

This page intentionally left blank.

Initial Distribution System Evaluation Report for Oak City

PWSID Number: US5555555

Address: 124 Oak Drive
Oak City, US 11111-1234

Contact Person: Mr. Joseph Smith, P.E.

Phone Number: 123-555-1111

Fax Number: 123-555-2222

Email Address: Jsmith@ci.oakcity.us

System Type: Community, ground water

Population Served: 200,000

This page intentionally left blank.

I. SMP PLAN

1. System Description:

This section of the report should include a summary of typical system operating characteristics (and how they change on a seasonal basis if appropriate) explaining how sources are used to meet system demands, where high water age is expected to occur, and any special aspects of operation that could affect DBP concentrations in the distribution system. Information about water treatment processes and source water quality data should also be in this section, including a brief description of the water treatment process train.

General system characteristics:

Service area: Oak City plus surrounding suburban areas
Production: Annual average daily demand = 20 MGD

Source Water Information:

Silver Springs Wellfield (Silver Aquifer)
- pH: from 7.0 to 7.5
- Alkalinity: from 125 to 175 mg/L as $CaCO_3$
- TOC: from 1.4 to 2.7 mg/L as C

Blue Springs Wellfield (Blue Aquifer)
- pH: from 6.9 to 7.3
- Alkalinity: from 82 to 198 mg/L as $CaCO_3$
- TOC: from 2.1 to 3.7 mg/L as C

Entry points and service areas under the influence of each entry point:
(Entry points should be tied to source(s) and typical flows noted.)

Entry points:
- Silver Plant (Silver Springs Wellfield), 25 MGD production capacity
  - Winter Average Production = 18 MGD
  - Summer Average Production =20 MGD
- Blue Pumping Station (Blue Springs Wellfield), 10 MGD production capacity
  - Winter Average Production = 0 MGD
  - Summer Average Production = 6 MGD

The second supply source (Blue Springs Wellfield) is necessary to cope with higher demand during the summer. The two wellfields draw from two different aquifers.

When the Blue Pumping Station is in service, customers located in the Cypressville, Cedarville, Poplarville, and north downtown generally receive water from the Blue Springs Wellfield.

Customers located in the Elmville, Oakville, Pineville, and south downtown generally receive water from the Silver Plant year round.

Customers located in the Weeping Willow Community, Appleville, and central downtown generally receive a mixture of water from both plants when both the Silver Plant and Blue Pumping Station are in service.

Treatment Provided:

Silver Plant: Direct filtration, chlorination, in service 12 months per year.
Blue Pumping Station: Chlorination, in service approximately three months per year, during the summer (over 60 consecutive days of operation).
Primary and residual disinfection: Chlorine/chloramines at both plants.

Description of distribution system:

Distribution system (estimated length of lines and range of diameter):
About 600 miles, 4" - 56"

The estimated range of residence time of water in the distribution system is 0 to 6 days.

5 storage tanks
1 ground tank 4 MG capacity
4 elevated tanks 6 MG total capacity (1.5 MG each)

Pump stations:
Station #1 is located at the ground storage tank. This pump is primarily used during peak demands and low pressure situations. The pump is timed to turn on in the morning and evening during peak demand, and when the pressure drops below 40 psi downstream of the station.

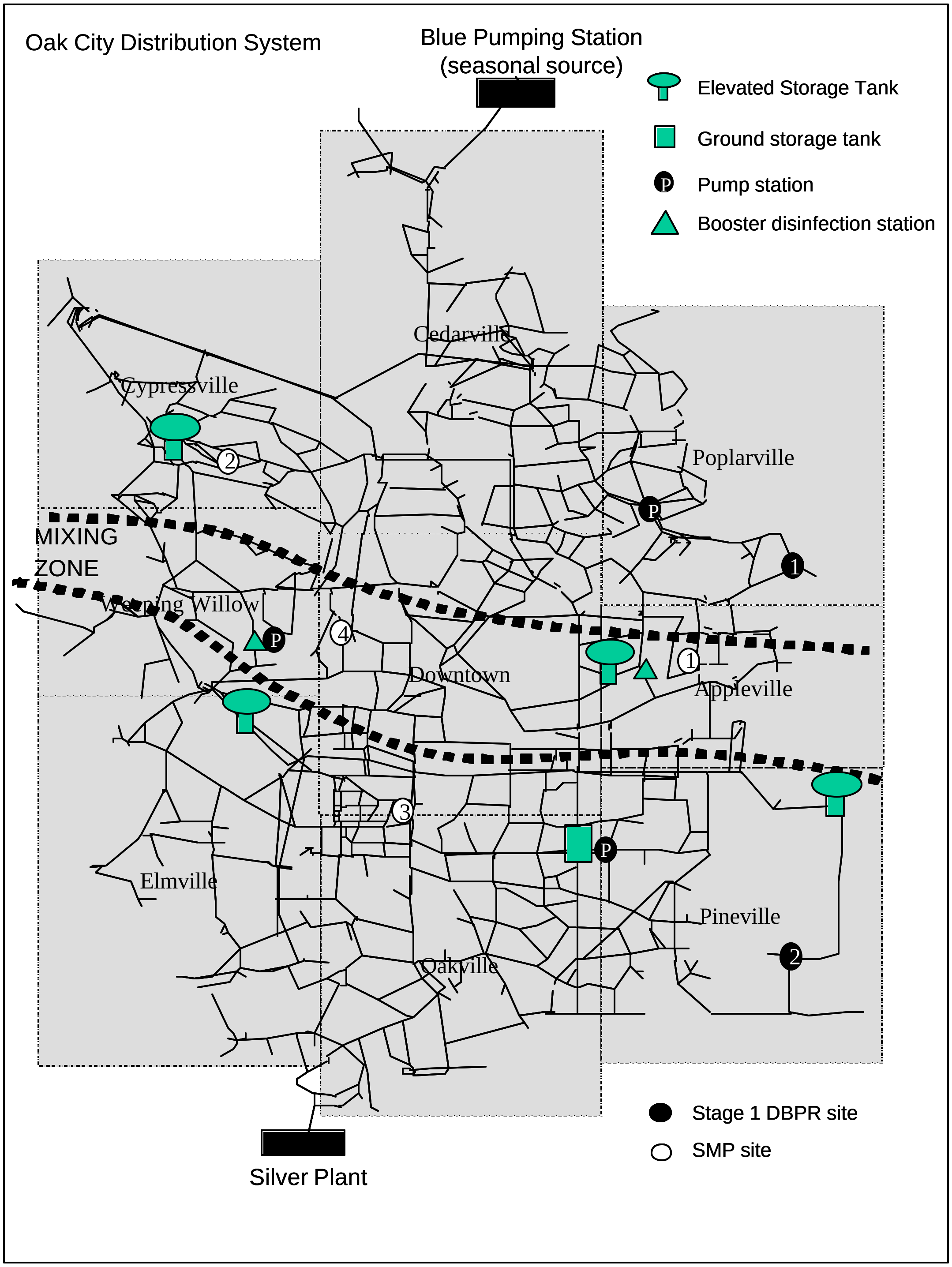
Stations #2 and #3. These pumps are used to boost system pressure when the pressure in the areas downstream of these pumps (Poplarville and Weeping Willow) drops below 40 psi.

Booster facilities:
Both facilities are total chlorine paced, and the target dose after boosting is 3.0 to 3.5 mg/L. Ammonia is added (residual ammonia before boosting is accounted for) to target a Cl_2:NH_3-N ratio of 4.5 to 4.0.

Facility #1 is located on Industrial Park Ave. (downstream from the Courthouse storage tank at pump station #3). This facility is occasionally used during the summer when low total chlorine residual (below 1.0 mg/L) are measured at remote locations downstream of the booster facility.

Facility #2 is located at the intersection of First Ave. and 13th St. (in a mixing zone) in an area of the distribution system where total chlorine residuals are frequently low.

2. Schematic of the distribution system with SMP and Stage 1 DBPR sites:



3. SMP monitoring requirements:

The system serves approximately 200,000 people and uses two ground water sources. Therefore, a total of 4 SMP sample sites (2 per plant) must be sampled approximately every 90 days (4 dual sample sets per quarter) for the IDSE.

Required SMP Sample Sites

SMP Site Type	Number of Sites in the Silver Plant Influence Zone	Number of Sites in the Blue Station Influence Zone
Representative of high TTHM	1	1
Representative of high HAA5	1	1

Available Data:

Report all data that helped in site selection. If you have bromide, TOC, or HPC data, these may be helpful for justifying Stage 2B site selection. For this example, tables with data from Stage 1 DBPR, Total Coliform Rule, and operational sample sites are presented. The sites chosen as SMP sample sites should also be noted for reference. Your report should include data for all sites that were considered as candidates for SMP sites.

Total chlorine and HPC data were available from Total Coliform Rule sample sites and the two Stage 1 DBPR sample sites. Distribution system water temperature varies over a small range between winter and summer, so chlorine data for November, February, May, and August were reviewed, and monthly averages and an overall average were calculated. The typical average water age at each site was also estimated based on results from the distribution system hydraulic model. Table F.1 presents this data, with sites grouped by summer time plant service area and then ordered from low to high by the yearly average total chlorine concentration. The selected SMP sample sites are numbered and their type identified for reference.

Quarterly HPC data were available for the same year and at the same sites as the chlorine data. The four results for each site were averaged. The quarterly results and yearly average values are presented in Table F.2. The results are presented following the order based on the yearly average HPC values.

Table F.1 Oak City Distribution System—Total Chlorine Data

Sample Site ID #	Source/ Plant	Stage 1 Site Type	SMP Site #	SMP Site Type	Total Chlorine (mg/L)				
					Nov.	Feb.	May	Aug.	Mean
Oper #9	SP		1	T	0.4	0.3	0.5	0.9	0.5
TCR #9	SP		3	H	0.9	1.2	1.0	0.9	1.0
TCR #4	SP				0.9	1.6	0.8	0.6	1.0
Stg. 1 #2	SP	Avg.			0.6	3.0	2.1	0.8	1.6
TCR #3	SP				1.8	1.8	1.5	2.7	2.0
TCR #6	SP				2.4	2.7	0.9	2.4	2.1
Oper #10	SP				1.8	1.3	2.4	3.6	2.3
Oper #20	SP				4.0	3.6	2.7	4.0	2.6
TCR #2	BP		2	T	0.6	1.2	0.9	1.0	0.9
TCR #5	BP				0.6	0.9	1.5	0.9	1.0
TCR #8	BP		4	H	1.8	1.3	1.6	0.9	1.4
TCR #1	BP				1.8	2.1	1.8	1.7	1.9
Stg. 1 #1	BP	Avg.			0.6	2.4	2.4	1.5	1.7
Oper #1	BP				1.8	2.7	3.3	2.4	2.6
TCR # 7	BP				2.7	2.1	3.0	3.6	2.9
Oper #30	BP				4.0	3.8	4.2	2.9	3.7

SP - Silver Plant
BP - Blue Plant
Oper. - Operational sample

TCR - Total Coliform Rule
Stg. 1 - Stage 1 DBPR

T - Representative High TTHM
H - Representative High HAA5

Table F.2 Oak City Distribution System—Heterotrophic Plate Counts (HPC)

Sample Site ID #	Source/ Plant	Stage 1 Site Type	SMP Site #	SMP Site Type	HPC (cfu/mL)				
					Nov.	Feb.	May	Aug.	Mean
Oper #9	SP		1	T	56	42	176	245	130
TCR #9	SP		3	H	54	65	65	82	67
TCR #4	SP				43	34	224	156	114
Stg. 1 #2	SP	Avg.			55	60	85	125	81
TCR #3	SP				53	42	72	84	63
TCR #6	SP				35	62	92	80	67
Oper #10	SP				0	0	0	5	1
Oper #20	SP				0	0	0	0	0
TCR #2	BP		2	T	70	212	132	356	242
Oper #30	BP				0	0	4	1	1
TCR #5	BP				280	163	263	96	201
TCR #8	BP		4	H	57	72	37	77	68
TCR #1	BP				56	43	43	143	71
Stg. 1 #1	BP	Avg.			25	52	82	70	57
Oper #1	BP				15	42	72	60	47
TCR # 7	BP				2	1	12	25	10

SP - Silver Plant
BP - Blue Plant
Oper. - Operational sample

TCR - Total Coliform Rule
Stg. 1 - Stage 1 DBPR

T - Representative High TTHM
H - Representative High HAA5

4. Summary of selected SMP sample sites

Present the rationale for the selection of the SMP sample sites.

Sample sites were chosen to represent diverse geographic areas of the distribution system. A description of the four SMP sites for the Oak City metro area distribution system is given below. The distribution system map in section I.2 shows these sites.

SMP Site #1 – Chosen to represent high TTHM levels in the Silver Plant influence zone and the mixing zone. This monitoring site is located before the last group of connections in proximity to the end of the distribution system in the mixing zone. At this site, water demand tends to be low, total chlorine levels are always low (ranging between 0.3 and 0.9 mg/L) and heterotrophic plate counts are often greater than 200 cfu/mL.

SMP Site #2 – Chosen to represent high TTHM levels in the Blue Pumping Station influence zone. This monitoring site is located after the first group of connections (approximately 0.5 miles) downstream of the Courthouse Reservoir (1.5 MG elevated storage facility) in the influence zone of the Blue Pumping Station.

SMP Site #3 – Chosen to represent high HAA5 levels in the Silver Plant influence zone. Sample tap is a hose bib at an elementary school located in a zone of the distribution system with water age greater than average. Total chlorine levels at this site range between 0.9 and 1.2 mg/L, and the heterotrophic plate count is consistently below 100 cfu/mL throughout the year.

SMP Site #4 – Chosen to represent high HAA5 levels in the Blue Pumping Station influence zone and the mixing zone. This site is a dedicated sampling site routinely used for monitoring water quality in downtown Oak City. In this area, the water age is greater than the average, the total chlorine is never below 0.9 mg/L and the heterotrophic count plate is usually low (below 100 cfu/mL). This area is believed to be in the mixing zone, receiving water from both the Blue Pumping Station and Silver Plant.

5. SMP Sample Schedule

Because the quarterly Stage 1 DBPR monitoring is the only DBP monitoring that has been performed in the Oak City system, historic DBP data is available for only the months of February, May, August, and November. August has regularly had the highest DBP levels. No other DBP data is available for any other months of the year, so water temperature data was also reviewed to see which month of the year had the warmest water temperature. Our review of three years of finished water temperature data from TCR sample sites showed that distribution system water was warmest in August. Therefore, based on the agreement of the water temperature and TTHM and HAA5 monitoring results, we concluded August is the controlling month for the Oak City distribution system. The following table summarizes our planned SMP sample dates and is based on sampling on the second Monday of the month.

Proposed SMP Sample Schedule

Planned Sample Date
November 8, 2005
February 14, 2006
May 9, 2006
August 8, 2006

Dual sample sets will be collected from each of the four SMP sample sites on or close to the listed dates and analyzed for TTHM and HAA5 by a State-certified laboratory. Stage 1 DBPR compliance samples will be collected on the same days.

6. Map of the distribution system showing major transmission mains, numbered Stage 1 DBPR compliance sites, and numbered SMP sample sites:

For this example, the map in Section I.2 was used to show SMP sample sites. The system in this example has only four SMP sites and two Stage 1 DBPR monitoring sites. Depending on the size of your system and the number of sample sites. It may be more appropriate (for clarity) to show SMP sites on a separate schematic in this section.

See map in section I.2.

II. SMP RESULTS

1. Introduction:

The SMP was conducted between November 2005 and August 2006. The following table presents the planned SMP sample dates, the actual dates when samples were collected, and the reason for the one deviation from the plan.

Actual SMP Sample Dates

Planned Sample Date	Actual Sample Date	Explanation
November 8, 2005	November 8, 2005	On schedule.
February 14, 2006	February 14, 2006	On schedule.
May 9, 2006	May 9, 2006	On schedule.
August 8, 2006	August 5, 2006	System maintenance was planned in the area of SMP site #1 for the week of August 8 and was expected to require extensive system flushing, so SMP sampling was performed on the prior Friday.

2. Summary of IDSE SMP data and Stage 1 DBPR compliance data:

All DBP results from the SMP and concurrent Stage 1 DBPR compliance monitoring are presented in the following tables. The first table presents the TTHM and HAA5 results for the SMP sample sites and the second table presents the results for the Stage 1 DBPR compliance sampling for the period from February 2005 to August 2006.

Oak City IDSE SMP Monitoring Results

SMP Sample Site	TTHM (μg/L)		HAA5 (μg/L)	
	Monitoring Results[1]	LRAA	Monitoring Results[1]	LRAA
#1 - Representative high TTHM (Silver)	62, 71, 82, 85	75	21, 25, 26, 28	25
#2 - Representative high TTHM (Blue)	49, 68, 72, 69	65	20, 21, 38, 28	27
#3 - Representative high HAA5 (Silver)	33, 29, 41, 42	36	43, 52, 48, 38	45
#4 - Representative high HAA5 (Blue)	35, 29, 37, 47	37	36, 40, 46, 40	41

[1] Data obtained from sampling every 90 days are listed in order for November, February, May, and August (as required for a ground water supply serving ≥10,000 people).

Oak City Stage 1 DBPR Monitoring Results

Stage 1 DBPR Monitoring Site	TTHM (µg/L) Monitoring Results[1]	TTHM (µg/L) LRAA	HAA5 (µg/L) Monitoring Results[1]	HAA5 (µg/L) LRAA
Maximum residence time #1	45, 34, 56, 62	49	24, 32, 43, 45	36
Maximum residence time #2	60, 68, 68, 98	74	42, 33, 30, 38	36

[1] Data obtained from sampling every 90 days are listed in order for November, February, May, and August (as required for a ground water supply serving ≥10,000 people).

III. PROPOSED STAGE 2B COMPLIANCE MONITORING SITES

1. Site Selection:

Two Stage 2B compliance sample sites were selected for each plant from the one Stage 1 DBPR site and two SMP sample sites per plant. The selections were based on the TTHM and HAA5 LRAAs. The sites with the highest LRAAs were selected, with one exception. The following tables rank the sites based on their TTHM and HAA5 LRAAs. The sites proposed as Stage 2B compliance sites are shaded in the tables. A schematic of the sites is presented in section III.4.

Proposed Stage 2B Compliance Monitoring Sites

Silver Plant				Blue Pumping Station			
TTHM		HAA5		TTHM		HAA5	
Site	LRAA (µg/L)	Site	LRAA (µg/L)	Site	LRAA (µg/L)	Site	LRAA (µg/L)
SMP #1	75	**SMP #3**	**45**	**SMP #2**	**65**	**SMP #4**	**41**
Stg. 1#2	**74**	Stg. 1#2	36	Stg. 1#1	49	Stg. 1#1	36
SMP #3	36	SMP #1	25	SMP #4	37	SMP #2	27

Note: **Bold text and shading** identify proposed Stage 2 DBPR compliance sites.

2. Justification of Site Selections:

For the Silver Plant, the proposed site for highest TTHM is Stage 1 DBPR site #2. This site had a LRAA nearly equal to the highest LRAA (74 vs. 75 µg/L at SMP #1), had the highest single test result for TTHM (98 vs. 85 µg/L at SMP #1), and had a higher HAA5 average than SMP #1 (36 vs 25 µg/L). Continuing the use of the Stage 1 DBPR site will also allow the city to maintain a longer continuous historical record of TTHM concentrations at a single location. The proposed site for highest HAA5 is SMP #3, which had the highest HAA5 LRAA of the three Silver Plant sample sites.

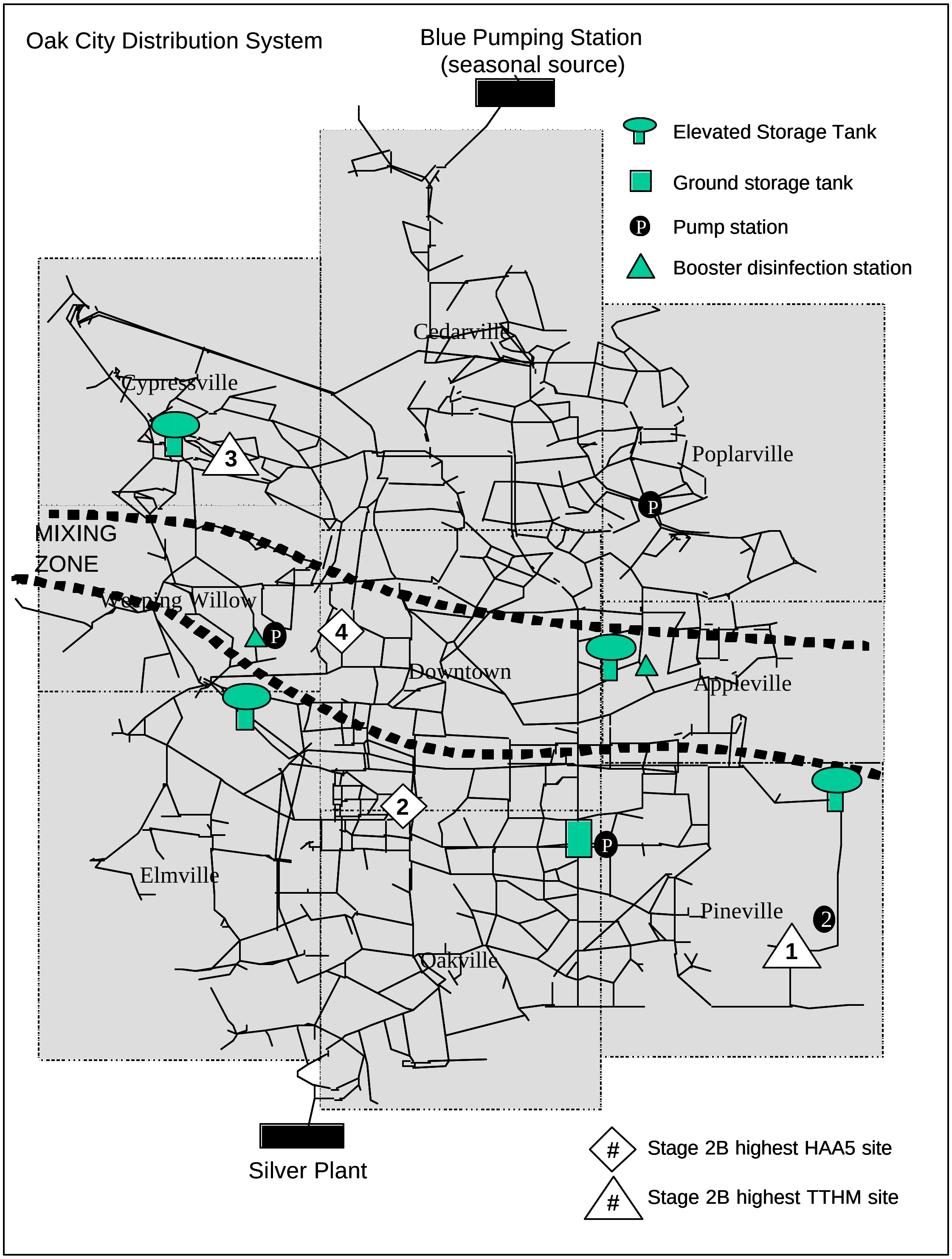
For the Blue Pumping Station, the proposed site for highest TTHM is SMP #2, since it had the highest TTHM average. The proposed site for highest HAA5 is SMP #4, which had the highest HAA5 average.

3. Summary of Proposed Compliance Sites and Sampling Schedule:

Stage 2B Sample Site	Site Description
1. Silver Plant Highest TTHM	Old Stage 1 DBPR Site #2
2. Silver Plant Highest HAA5	SMP Site #3
3. Blue Pumping Station Highest TTHM	SMP Site #2
4. Blue Pumping Station Highest HAA5	SMP Site #4

Dual sample set Stage 2B sampling is proposed to occur in March, June, August (peak historical month for TTHM concentrations), and December.

4. Map of Proposed Stage 2B Compliance Monitoring Sites:



Appendix G

IDSE SMP Report for Producing Surface Water Systems Serving 500 - 9,999 People

This appendix is provided as an example IDSE report for producing surface water systems serving 500 to 9,999 people and opting to complete the Standard Monitoring Program (SMP).

Chapter 6 presents the detailed SMP requirements for these systems, and Chapter 8 provides guidance on selecting SMP sites and Stage 2B compliance monitoring sites based on SMP results. Chapter 8 also presents the IDSE reporting requirements. The application of the basic guidance on SMP site selection and Stage 2 B compliance monitoring site selection is shown in this example, along with several instances of the use of best professional judgement being applied.

The italicized text within the appendix consists of comments and explanations and is not intended to represent the recommended content of an actual IDSE Report.

This page intentionally left blank.

Initial Distribution System Evaluation Report for Lakeside City

PWSID Number: US0000000

Address: P.O. Box 1234
Lakeside City, US 22222-1234

Contact Person: Ms. Mary Smith, P.E.

Phone Number: 123-555-1111

Fax Number: 123-555-2222

Email Address: Msmith@ci.lakeside.us

System Type: Community, surface water

Population Served: 3,000

This page intentionally left blank.

I. SMP PLAN

1. System Description:

This section of the report should include a summary of typical system operating characteristics (and how they change on a seasonal basis if appropriate) explaining how sources are used to meet system demands, where high water age is expected to occur, and any special aspects of operation that could affect DBP concentrations in the distribution system. Information about water treatment processes and source water quality data should also be in this section, including a brief description of the water treatment process train.

General System Characteristics:

Service area: Lakeside City – the system serves an area within a three-mile radius
Production: Annual average daily demand 1 MGD

Source Water Information:

Deep Lake water quality data:

pH: from 6.8 to 7.9
Alkalinity: from 77 to 94 mg/L as $CaCO_3$
TOC: from 1.6 to 4.4 mg/L as C

Entry points (tied to source(s)) and identification of service area(s) under the influence of each entry point:
(Entry points should be tied to source(s) and typical flows noted)

Entry points: Deep Lake Plant Design Capacity = 2.5 mgd
Average Daily Production = 1.0 mgd

Treatment Provided:

Deep Lake Plant: alum coagulation, flocculation, sedimentation, and dual media filters.
Disinfection: chlorine for both primary and secondary disinfection.

Description of distribution system:

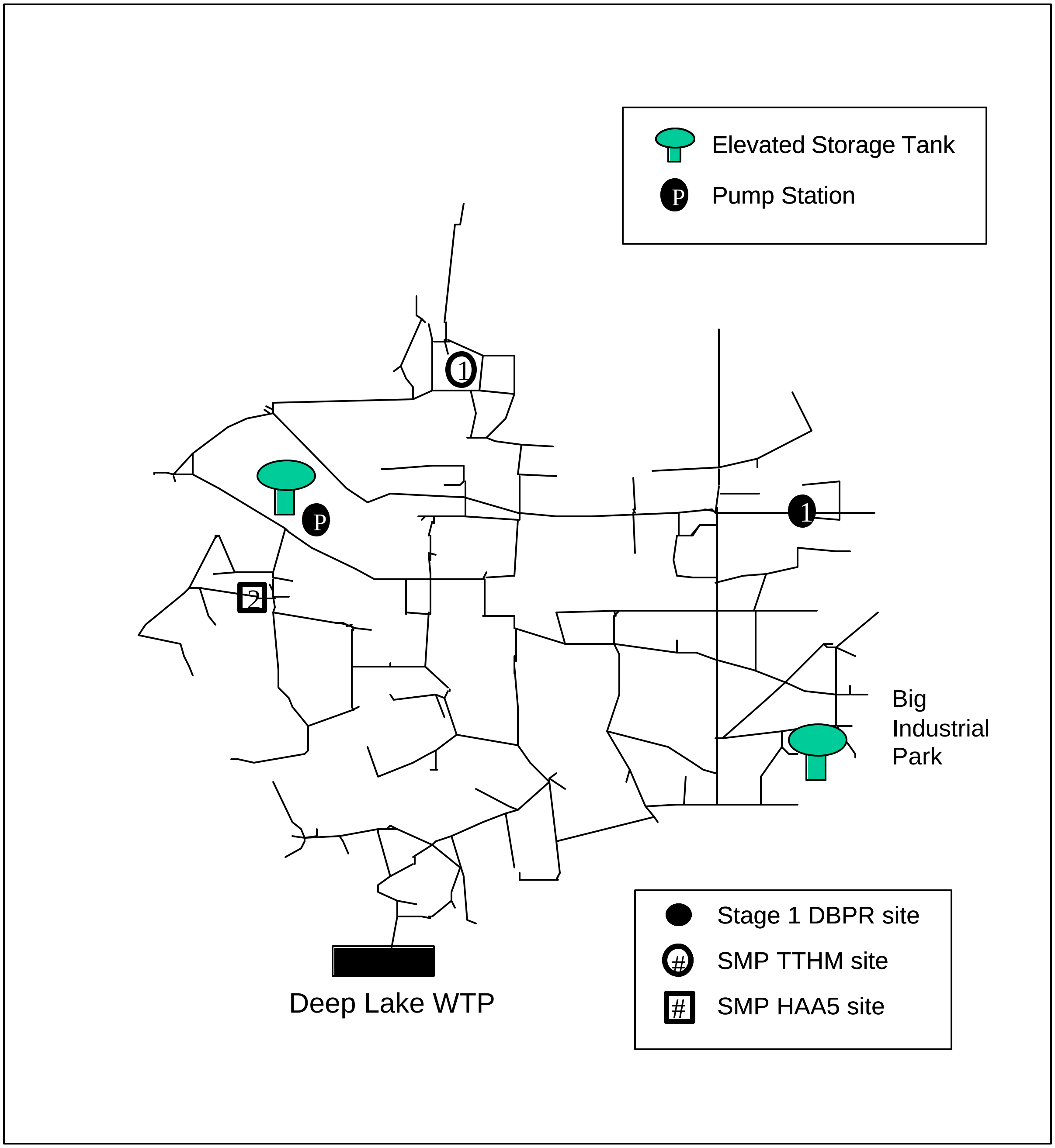
Distribution system (estimated length of lines and range of diameter):
About 20 miles, 4" - 12"

2 elevated tanks with total capacity of 0.5 MG

A pump station is located near the western storage tank (most distant from the plant). This pump is primarily used during peak demands and low pressure situations. The pump is timed to turn on in the morning and evening during peak demand and when the pressure drops below 40 psi at a point downstream of the pump station.

The residence time of water in the distribution system is believed to average approximately 2 days, and ranges up to nearly 5 days.

<u>2. Schematic drawing of the distribution system with SMP and Stage 1 DBPR sites:</u>



3. SMP monitoring requirements:

The Lakeside City system serves approximately 3,000 people and has one surface water plant. Therefore, a total of 2 SMP sample sites are required by the Stage 2 DBPR to be sampled approximately every 90 days (2 dual sample sets per quarter).

Required SMP Sample Sites

SMP Site Type	Number of Sites
Representative of high TTHM	1
Representative of high HAA5	1

Available Data:

Report all data that helped in sample site selection. If you have bromide, TOC, or HPC data, these may be helpful for justifying Stage 2B site selection. For this example, only limited tables are presented with data for Stage 1 DBPR sample sites and the sites chosen as SMP sample locations. Your report should include data for all sites that were considered as candidates for SMP sites.

Chlorine residual information was available for Total Coliform Rule sample sites, the Stage 1 DBPR sample site, and the operational sample site. In addition, HPC data was available for Total Coliform Rule sample sites. The following table presents these data, with the selected SMP sample sites numbered and their type identified for reference.

Table G.1 Lakeside Distribution System—Free Chlorine Residual Data

Sample Site ID #	SMP Site #	SMP Site Type	Free Chlorine Residual (mg/L)															
			7/ 04	8/ 04	9/ 04	10/ 04	11/ 04	12/ 04	1/ 05	2/ 05	3/ 05	4/ 05	5/ 05	6/ 05	7/ 05	8/ 05	9/ 05	10/ 05
Stg. 1			0.14			0.32			0.68			0.63			0.20			0.45
Oper. #1			1.5	1.5	1.4	1.2	1.1	1.2	1.1	1.1	1.2	1.2	1.4	1.4	1.4	1.5	1.3	1.2
TCR #3	1	T	0.12	0.10	0.22	0.34	0.44	0.48	0.65	0.62	0.59	0.65	0.62	0.24	0.23	0.25	0.39	0.44
TCR #2	2	H	0.41	0.42	0.46	0.51	0.58	0.48	0.70	0.60	0.72	0.61	0.54	0.42	0.42	0.40	0.47	0.51
TCR #1			0.32	0.35	0.42	0.54	0.75	0.66	0.82	0.70	0.70	0.91	0.55	0.46	0.36	0.35	0.40	0.64

TCR - Total Coliform Rule
Stg. 1 - Stage 1 DBPR
Oper. - Operational sample
T - Representative High TTHM
H - Representative High HAA5

Table G.2 Lakeside Distribution System—Heterotrophic Plate Counts (HPC)

Sample Site ID#	SMP Site #	SMP Site Type	HPC (cfu/mL)					
			7/04	10/ 04	1/05	4/05	7/05	10/05
Stg. 1			468	223	76	72	423	98
Oper. #1			0	0	0	0	0	0
TCR #3	1	T	540	202	85	67	342	102
TCR #2	2	H	97	75	23	31	98	59
TCR #1			95	53	15	19	76	48

TCR - Total Coliform Rule
Stg. 1 - Stage 1 DBPR
Oper. - Operational sample
T - Representative High TTHM
H - Representative High HAA5

<u>**4. Summary of the selected SMP sample sites:**</u>

Present the rationale for the selection of the SMP sample sites in your system, as well as a schematic showing their locations within the distribution system.

The system has only one source. Therefore, a total of two SMP monitoring sites are required by the Stage 2 DBPR. Each monitoring site is marked on the map of the distribution system (see section I.2). Residual chlorine and HPC data from the TCR and operational monitoring sites (see Tables G.1 and G.2) were considered in the selection of the SMP monitoring sites.

<u>SMP Site #1</u> – Chosen to represent high TTHM levels. This monitoring site is located in the vicinity of TCR sample site # 3, and before the last group of connections in proximity to the end of the distribution system. At this site, water demand tends to be low, chlorine residuals are often very low (less than 0.5 mg/L) and heterotrophic plate counts are often higher than 100 cfu/mL.

<u>SMP Site #2</u> – Chosen to represent high HAA5 levels. Sample tap is a hose bib at an elementary school located in a zone of the distribution system with water age greater than average. Chlorine residual at this site is never below 0.4 mg/L (range is between 0.4 and 0.7 mg/L), and the heterotrophic plate count is consistently below 100 cfu/mL throughout the year.

<u>**5. SMP sample schedule:**</u>

Because the quarterly Stage 1 DBPR monitoring is the only DBP monitoring that has been performed in the Lakeside City system, historic DBP data are available for only the months of February, May, August, and November. August has regularly had the highest DBP levels. No other DBP data are available for any other months of the year, so water temperature data from TCR sample sites were also reviewed to see which month of the year had the warmest water temperature. Our review of 3 years of temperature data showed that distribution system water was warmest in August. Therefore, based on the agreement of the water temperature and TTHM and HAA5 monitoring results, we concluded that August is the controlling month for the Lakeside City distribution system. The following table summarizes our planned SMP sample dates, which are based on sampling on the second Monday of the month.

Proposed SMP Sample Schedule

Planned Sample Date
November 13, 2007
February 12, 2008
May 14, 2008
August 13, 2008

Dual sample sets will be collected from each of the 2 SMP sample sites on or close to the listed dates and analyzed for TTHM and HAA5 by a State-certified laboratory. Stage 1 DBPR compliance samples will be collected on the same days.

II. SMP Results

1. Introduction

The SMP was conducted between November 2007 and August 2008. The following table presents the planned SMP sample dates, the actual dates when samples were collected, and the reason for the one deviation from the plan.

Actual SMP Sample Schedule

Planned Sample Date	Actual Sample Date	Explanation
November 13, 2007	November 13, 2007	On schedule.
February 12, 2008	February 12, 2008	On schedule.
May 14, 2008	May 14, 2008	On schedule
August 13, 2008	August 17, 2008	One of the sample bottles broke from the August 10 sampling, so re-sample was performed 4 days later.

2. Summary of IDSE SMP data and Stage 1 DBPR compliance data.

All DBP results from the SMP and concurrent Stage 1 DBPR compliance monitoring are presented in the following two tables. The first table presents the TTHM and HAA5 results for the SMP sample sites and the second table presents the results for the Stage 1 DBPR compliance sampling for the period from November 2007 to August 2008.

Lakeside City IDSE SMP Monitoring Results

SMP Sample Site	TTHM (µg/L)		HAA5 (µg/L)	
	Monitoring Results[1]	LRAA	Monitoring Results[1]	LRAA
#1 - Representative high TTHM	63, 53, 78, 89	71	21, 25, 32, 41	30
#2 - Representative high HAA5	38, 32, 48, 56	44	43, 49, 53, 63	52

[1] Data obtained from sampling every 90 days (as required for surface water supplies serving 500-9,999 people) are listed in order for November, February, May, and August.

Lakeside City Stage 1 DBPR Monitoring Results

SMP Sample Site	TTHM (µg/L)		HAA5 (µg/L)	
	Monitoring Results[1]	Avg	Monitoring Results[1]	Avg
Maximum residence time	56, 49, 79, 95	70	25, 30, 36, 51	36

3. Proposed Stage 2B Compliance Sites and Schedule:

Two Stage 2B compliance sample sites were selected from among the one Stage 1 DBPR and two SMP sample sites. The selections were based on the TTHM and HAA5 LRAAs. The following table ranks the sites based on their TTHM and HAA5 LRAAs. The sites proposed as Stage 2B compliance locations are shaded in the table.

Proposed Stage 2 B Compliance Sites

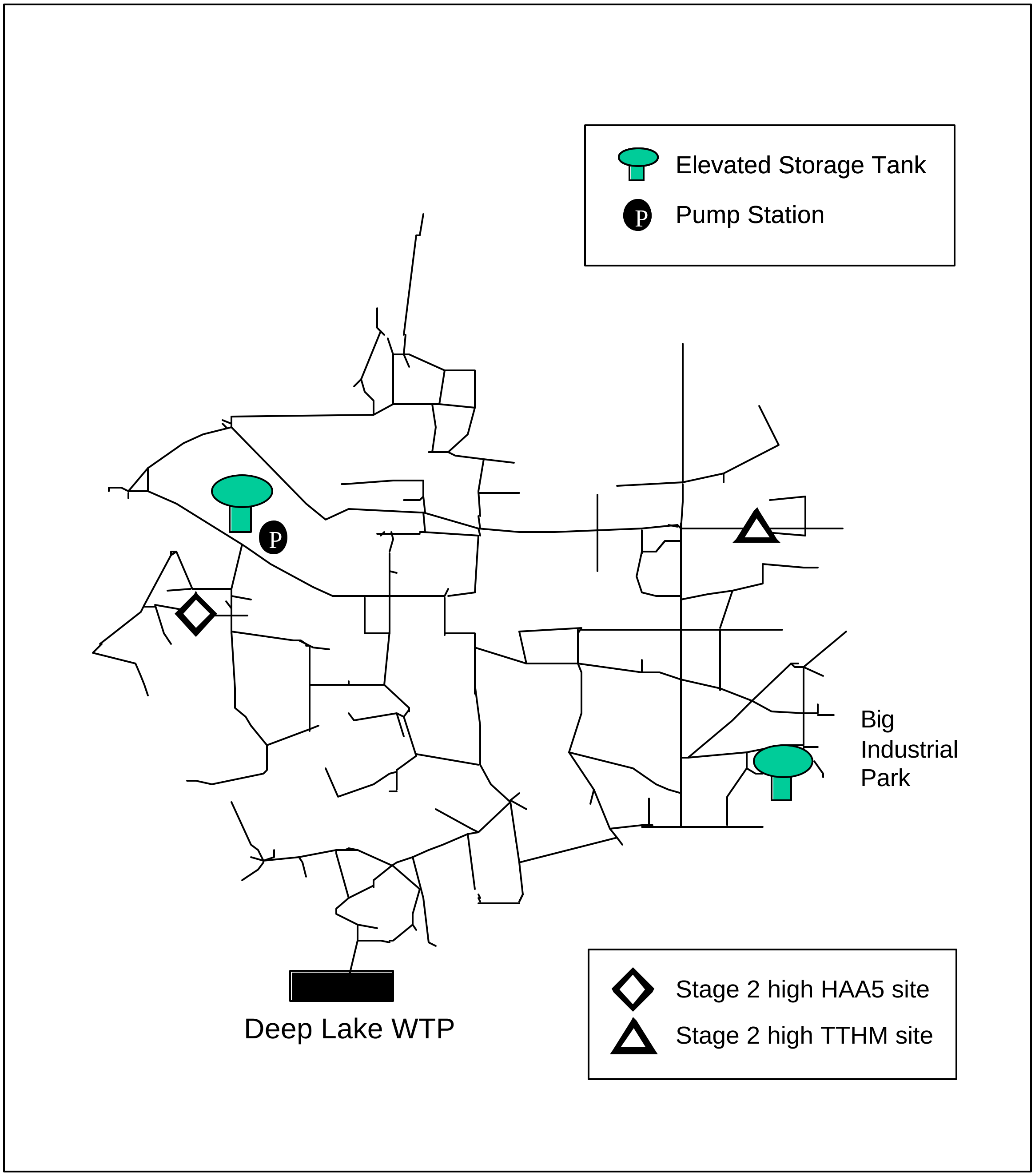
TTHM		HAA5	
Site	LRAA (µg/L)	Site	LRAA (µg/L)
SMP #1	71	**SMP #2**	**52**
Stage 1	**70**	Stage 1	36
SMP #2	44	SMP #1	30

Note: **Bold text and shading** identify proposed Stage 2B compliance sites.

The proposed highest HAA5 site is SMP #2, which had the highest LRAA of the three sample locations. The proposed highest TTHM site is the Stage 1 DBPR site. This site had an LRAA nearly equal to the highest LRAA (70 vs. 71 µg/L at SMP #1), and had the highest single test result for TTHM (95 vs. 89 µg/L at SMP #1). It also had a higher HAA5 LRAA than SMP #1 (36 vs. 30 µg/L). Continuing to use the Stage 1 DBPR site will also allow the city to maintain a continuous historical record of TTHM concentrations at a single location.

Dual sample set Stage 2 B sampling is proposed to occur in March, June, August (peak historical month for TTHM concentrations), and December.

4. Schematic drawing of the distribution system with Stage 2B sites:



Appendix H

IDSE Report for
Producing Ground Water Systems Serving < 10,000 People

This appendix is provided as an example IDSE report for producing ground water systems serving less than 10,000 people and opting to complete the Standard Monitoring Program (SMP).

Chapter 7 presents the detailed SMP requirements for these systems, and Chapter 8 provides guidance on selecting SMP sites and Stage 2B compliance monitoring sites based on SMP results. Chapter 8 also presents the IDSE reporting requirements. The application of the basic guidance on SMP site selection and Stage 2B compliance monitoring site selection is shown in this example, along with several instances of the use of best professional judgement being applied.

The italicized text within the appendix consists of comments and explanations and is not intended to represent the recommended content of an actual IDSE Report.

This page intentionally left blank.

Initial Distribution System Evaluation Report for Greenspring City

PWSID Number: US0000000

Address: P.O. Box 1234
Greenspring City, US 11111-1234

Contact Person: Ms. Jennifer Smith, P.E.

Phone Number: 123-555-9876

Fax Number: 123-555-9877
Email Address: Jsmith@ci.greenspring.us

System Type: Community, ground water

Population Served: 1,500

This page intentionally left blank.

I. SMP PLAN

1. System Description:

This section of the report should include a summary of typical system operating characteristics (and how they change on a seasonal basis if appropriate) explaining how sources are used to meet system demands, where high water age is expected to occur, and any special aspects of operation that could affect DBP concentrations in the distribution system. Information about water treatment processes and source water quality data should also be in this section, including a brief description of the water treatment process train.

General system characteristics:

Service area: All of Greenspring City—an area of approximately 4 square miles
Production: Annual average daily demand - 250,000 gpd

Source water information:

Greenspring Wellfield water quality data:

pH typically ranges from 6.8 - 7.5
Alkalinity averages 185 mg/L as $CaCO_3$
TOC averages 1.5 mg/L as C

Entry points (tied to source and identification of service area under influence of each):
(Entry points should be tied to source(s) and typical flows noted)

Green Hill Water Plant located at Greenspring Wellfield—the only entry point, feeds entire distribution system

Design Capacity = 1.0 mgd
Average Daily Production = 0.25 mgd

Treatment provided:

Green Hill Water Plant adds chlorine for primary and secondary disinfection

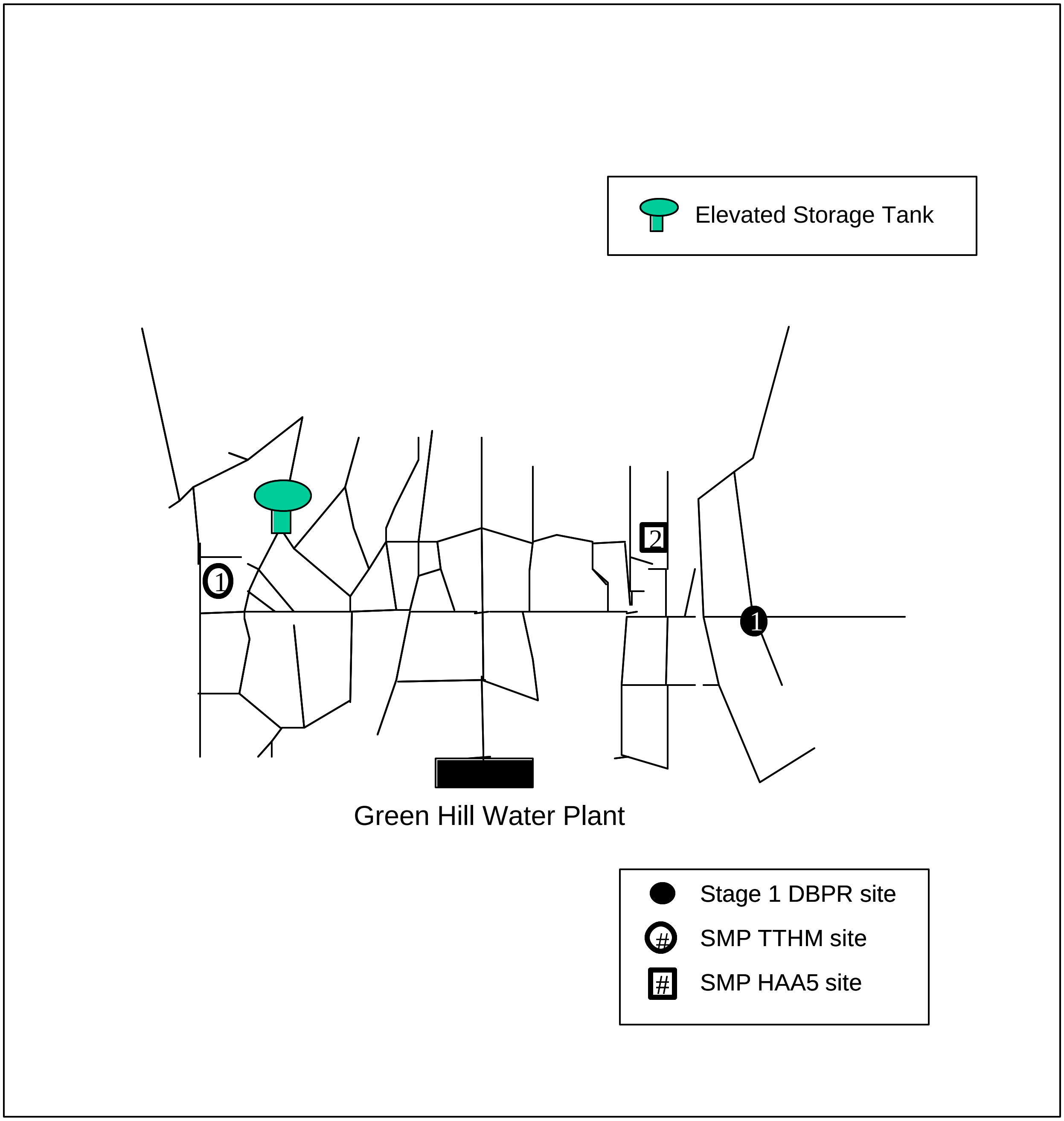
Description of distribution system:

Distribution system (estimated length of lines and range of diameter):
About 7 miles, 4" - 12"

Number of storage tanks and total storage capacity:
1 ground tank at the Green Hill water plant (0.05 MG) and 1 elevated tank (0.25 MG)

The average residence time of water in the distribution system is believed to be 1 day, and may range up to nearly 3 days at the ends of the system.

2. Schematic of the distribution system:



3. SMP monitoring requirements:

The Greenspring City system serves approximately 1,500 people. This is a ground water system, served by one aquifer. Therefore, for the IDSE, a total of 2 SMP sample sites must be sampled approximately every six months (2 dual sample sets every six months).

SMP Site Requirements

Site Criteria	Number of Sample Sites
Representative high TTHM	1
Representative high HAA5	1

Available Data:

Report all data that helped in sample site selection. For this example, only tables with limited data are presented for Stage 1 DBPR sample sites and the sites chosen as SMP sample locations. If you have bromide, TOC and/or HPC data, these may be helpful for justifying Stage 2B site selection. Your report should include data for all sites that were considered as SMP sites.

Chlorine residual was available for the system's two Total Coliform Rule sample sites, the Stage 1 DBPR sample site, and the operational sample site. The following table presents these data, with SMP site numbers and types provided for those sites chosen for SMP monitoring.

Table H.1 Greenspring Distribution System—Chlorine Residual Data

Sample Site ID #	SMP Site #	SMP Site Type	Free Chlorine Residual (mg/L)																							
			1/03	2/03	3/03	4/02	5/03	6/03	7/03	8/03	9/03	10/03	11/03	12/03	1/04	2/04	3/03	4/04	5/04	6/04	7/04	8/04	9/04	10/04	11/04	12/04
Stg 1										0.25												0.28				
TCR #2	1	TTHM	0.61	0.63	0.59	0.38	0.37	0.25	0.21	0.23	0.22	0.34	0.44	0.48	0.65	0.62	0.59	0.61	0.62	0.24	0.23	0.25	0.39	0.44	0.49	0.53
Avg.	2	HAA5	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
TCR #1			0.73	0.68	0.55	0.42	0.42	0.40	0.41	0.42	0.46	0.51	0.58	0.48	0.70	0.60	0.72	0.61	0.54	0.42	0.42	0.40	0.47	0.51	0.56	0.48
FW			1.3	1.0	1.2	1.2	1.4	1.5	1.5	1.6	1.4	1.2	1.1	1.1	1.2	1.1	1.3	1.4	1.4	1.4	1.5	1.5	1.4	1.2	1.1	1.0

TCR - Total Coliform Rule
Stg. 1 - Stage 1 DBPR
FW - Finished Water (operational sample site)
Avg - Average Residence Time (operational sample site)

4. Summary of selected SMP sample sites:

Present the rationale for the selection of the SMP sample sites in your system, as well as a schematic showing their locations within the distribution system.

SMP Site #1 – Chosen to represent high TTHM levels. This is TCR site #2. This site is at the end of the distribution system, before the last significant group of connections, at a hose bib at the town library. It is located near TCR monitoring site #1, downstream of the storage tank, and before the last group of connections in proximity to the end of the distribution system. At this site, chlorine residuals are often very low (less than 0.5 mg/L). This site also represents high residence time within the distribution system.

SMP Site #2 – Chosen to represent high HAA5 levels. This site is a hose bib at an elementary school located in a zone of the distribution system with water age greater than average (based on operators' knowledge of the distribution system) but less than that of SMP #1. Free chlorine is not routinely monitored at this site. However, this site is expected to have higher chlorine residual than the TTHM SMP site, and therefore less potential for biodegradation. This site was also chosen to provide good geographical representation of the distribution system (although TCR #1 had free chlorine data, it was physically too close to SMP #1 to be considered).

5. SMP sample schedule:

Because the yearly Stage 1 DBPR monitoring is the only DBP monitoring that has been performed in the Greenspring system, historic DBP data are available for only the month of August. No other DBP data are available for any other months of the year, so water temperature data were also reviewed to see which month of the year had the warmest water temperature. Our review of 3 years of finished water temperature data from TCR sample sites showed that distribution system water was warmest in August. Therefore, based on the agreement of the water temperature and TTHM and HAA5 monitoring results, we concluded that August is the controlling month for the Greenspring City distribution system. The following table summarizes our planned SMP sample dates and is based on sampling on the second Monday of the month.

Proposed SMP Sample Schedule

Planned Sample Date
February 12, 2008
August 13, 2008

Dual sample sets will be collected from each of the 2 SMP sample sites on or close to the listed dates and analyzed for TTHM and HAA5 by a State-certified laboratory. Stage 1 DBPR compliance samples will be collected on the same days.

II. SMP RESULTS

1. Introduction:

The SMP was conducted in February and August 2008. The following table presents the planned SMP sample dates, the actual dates when samples were collected, and the reason for the one deviation from the plan.

Actual SMP Sample Schedule

Planned Sample Date	Actual Sample Date	Explanation
February 12, 2008	February 13, 2008	Sampler was sick on 2/12/08
August 13, 2008	August 13, 2008	On schedule

2. Summary of IDSE SMP data and Stage 1 DBPR compliance data.

All DBP results from the SMP and concurrent Stage 1 DBPR compliance monitoring are presented in the following two tables. The first table presents the TTHM and HAA5 results for the SMP sample sites and the second table presents the results for the Stage 1 DBPR compliance sampling for the period from February 2008 to August 2008.

Greenspring City SMP Monitoring Results

	TTHM (µg/L)			HAA5 (µg/L)		
SMP Sample Site	2/08	8/08	LRAA	2/08	8/08	LRAA
#1 - Representative high TTHM	**35**	**73**	**54**	**22**	**50**	**36**
#2 - Representative high HAA5	25	55	40	23	49	36

Note: **Bold text and shading** identify proposed Stage 2B compliance sites.

Greenspring City Stage 1 DBPR Monitoring Results

Stage 1 DBPR Sample Site	TTHM (µg/L)			HAA5 (µg/L)		
	2/08	8/08	LRAA	2/08	8/08	LRAA
Maximum Residence Time	**47**	**63**	**55**	**22**	**44**	**33**

Note: **Bold text and shading** identify proposed Stage 2B compliance sites.

3. Proposed Stage 2B Compliance Sites and Schedule:

Stage 2B compliance sample sites were selected from among the two SMP sample sites and one Stage 1 DBPR site. The selections were based on the LRAAs for TTHM and HAA5.

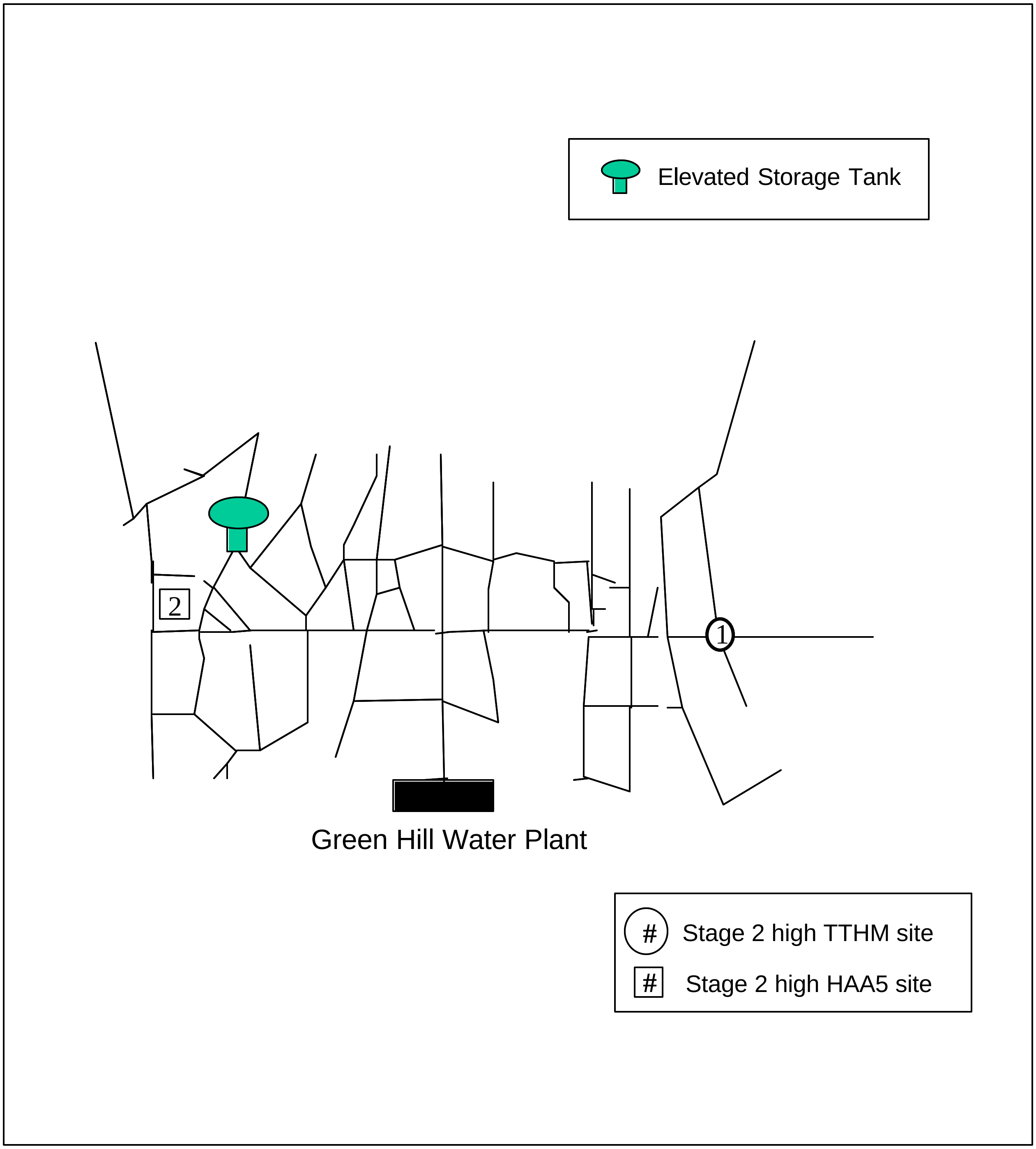
Proposed Stage 2B Compliance Sites

Stage 2B Site Number	Site Type	Location Description
1	Highest TTHM	Stage 1 DBPR #1
2	Highest HAA5	SMP #1

The proposed site for high TTHM is the Stage 1 DBPR site, which had an LRAA of 55 µg/L. The highest HAA5 LRAA occurred at both SMP #1 and SMP #2. The HAA5 values during the peak temperature months were similar for these two sites. Because SMP #1 has a higher TTHM LRAA than SMP #2, it was chosen as the second Stage 2B compliance monitoring site.

Dual sample set Stage 2B sampling is proposed to occur in February and August (the peak historical month for TTHM concentrations).

4. Schematic of the distribution system with Stage 2B sites:



This page intentionally left blank.

Appendix I

IDSE SMP Report for Producing Surface Water Systems Serving < 500 People

This appendix is provided as an example IDSE report for producing surface water systems serving less than 500 people and opting to complete the Standard Monitoring Program (SMP).

Chapter 7 presents the detailed SMP requirements for these systems, and Chapter 8 provides guidance on selecting SMP sites and Stage 2B compliance monitoring sites based on SMP results. Chapter 8 also presents the IDSE reporting requirements. The application of the basic guidance on SMP site selection and Stage 2B compliance monitoring site selection is shown in this example, along with several instances of the use of best professional judgement being applied.

The italicized text within the appendix consists of comments and explanations and is not intended to represent the recommended content of an actual IDSE Report.

This page intentionally left blank.

Initial Distribution System Evaluation Report for Riverdale

PWSID Number: US0000000

Address: P.O. Box 1234
Riverdale, US 22222-1234

Contact Person: Mr. John Jones, P.E.

Phone Number: 123-555-1111

Fax Number: 123-555-2222

Email Address: JJones@ci.riverdale.us

System Type: Community ground water under direct influence

Population Served: 300

This page intentionally left blank.

I. SMP PLAN

1. System Description:

This section of the report should include a summary of typical system operating characteristics (and how they change on a seasonal basis if appropriate) explaining how sources are used to meet system demands, where high water age is expected to occur, and any special aspects of operation that could affect DBP concentrations in the distribution system.

Information about water treatment processes and source water quality data is also part of this section, including a description of water treatment trains. General information about residence times within the distribution system should also be included, if available.

General System Characteristics:

Service area: Riverdale
Production: Annual average daily demand 40,000 gpd

Source Water Information:

Green Meadows spring:
pH: from 6.8 to 7.9
Alkalinity: from 77 to 94 mg/L as $CaCO_3$
TOC: from 1.6 to 2.4 mg/L as C

Entry points (tied to source(s)) and identification of service area(s) under the influence of each entry point:

Entry points: Green Meadows well field

Treatment Provided:

Green Meadows well field: Direct filtration
Primary and residual disinfection: Chlorine/chlorine

Description of distribution system:

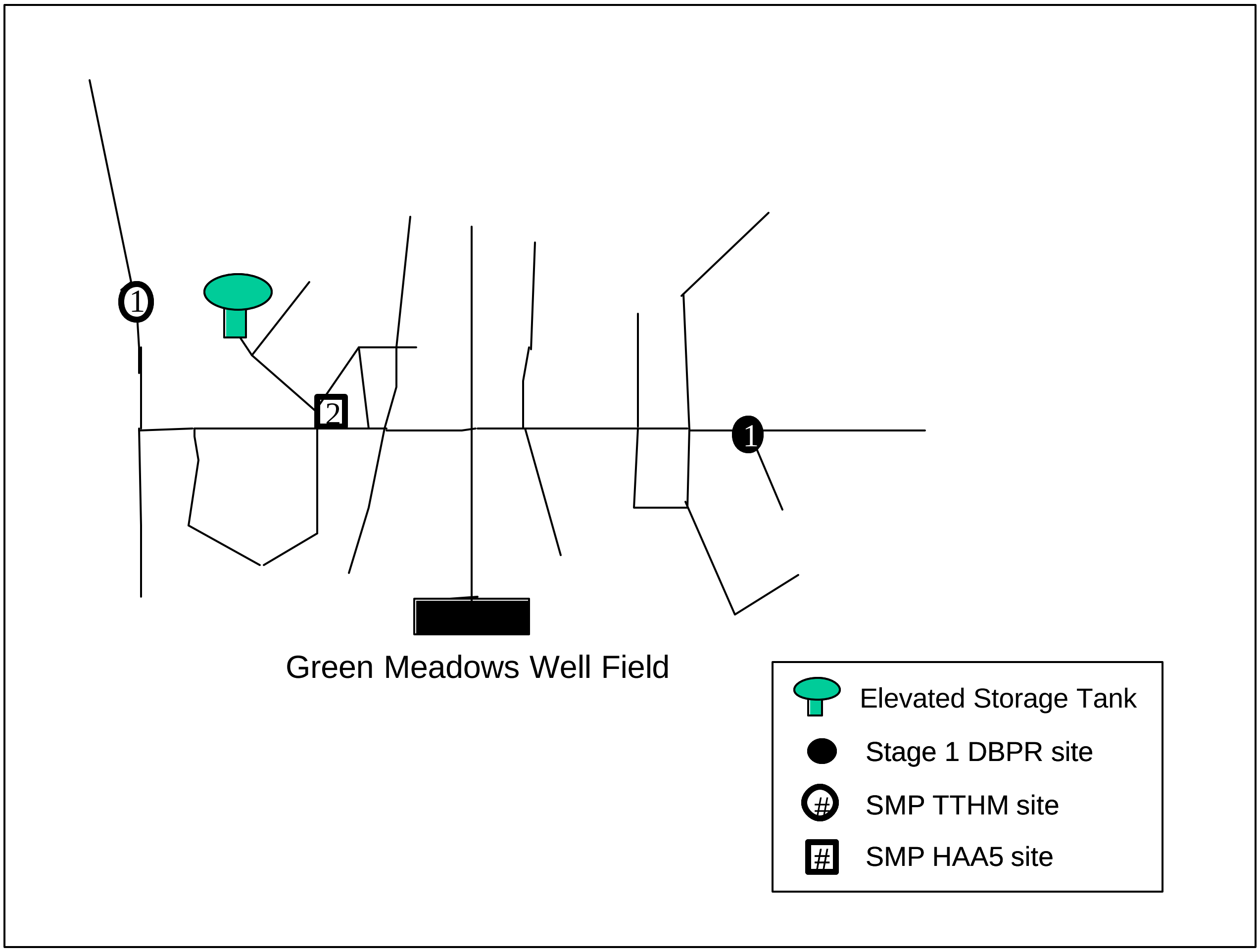
Distribution system (estimated length of lines and range of diameter):
About 1 mile, 4" - 6"

1 standpipe with total capacity of 50,000 gallons

Riverdale did not receive a very small system waiver from the State because the standpipe, which is used to maintain system pressure in the western half of the system, was considered oversized and may contribute to excessive residence times in the tank. Chlorine residual measurements in the tank show that it may be operating in a last-in/first-out mode, and water at the top of the tank may be much older than water in the bottom of the tank. Furthermore, the Green Meadows spring is situated in the center of the Riverdale system, while the Stage 1 DBPR monitoring site is located on the east side of the system. The State suggested that the western half of the system be monitored, upstream and downstream of the storage tank.

The residence time of water in the distribution system is thought to average approximately 1 day, but is probably higher near the standpipe.

2. Schematic drawing of the distribution system:



3. SMP monitoring requirements:

The Riverdale system serves approximately 300 people. This is a system using ground water under the direct influence of surface water and is served by one plant. Therefore, a total of 2 SMP sample sites are required by the Stage 2 DBPR to be sampled approximately every six months (2 dual sample sets every six months).

SMP Site Requirements

Site Criteria	Number of Sample Sites
Representative high TTHM	1
Representative high HAA5	1

Available Data:

Provide all data that helped in site selection. You can include are data from Stage 1 DBPR, Total Coliform Rule, and operational sample sites (any site not used for rule compliance). You should also provide residence times in the distribution system, if known. If you have bromide, TOC, or HPC data, these may be helpful for justifying your Stage 2B site selection. Your report should include data for all sites that were considered as candidates for SMP locations.

Chlorine residual information was available at Total Coliform Rule and operational sample sites. A summary of chlorine residual data in the distribution system is presented in Table I.1. The chlorine residual results from a study of water flow through the storage tank are shown in Table I.2.

Table I.1 Riverdale Distribution System—Chlorine Residual Data

Sample Site ID	Chlorine Residual (mg/L)																							
	1/05	2/05	3/05	4/05	5/05	6/05	7/05	8/05	9/05	10/05	11/05	12/05	1/06	2/06	3/06	4/06	5/06	6/06	7/06	8/06	9/06	10/06	11/06	12/06
WF #1	1.3	1.0	1.2	1.2	1.4	1.5	1.5	1.6	1.4	1.2	1.1	1.1	1.2	1.1	1.3	1.4	1.4	1.4	1.5	1.5	1.4	1.2	1.1	1.0
TCR #1	0.71	0.62	0.59	0.41	0.37	0.27	0.23	0.21	0.23	0.35	0.43	0.48	0.63	0.62	0.58	0.62	0.61	0.31	0.25	0.24	0.41	0.44	0.51	0.62

WF - Wellfield finished water
TCR - Total Coliform Rule

Table I.2 Riverdale Distribution System—Chlorine Residual Data at Storage Tank

Water Depth[1]	Test 1	Test 2	Test 3	Average
1 ft from top	ND	ND	ND	ND
3 ft from top	ND	0.1	0.1	0.10
5 feet from top/bottom	0.2	0.3	0.2	0.23
3 ft from bottom	0.7	0.9	0.8	0.80
1 ft from bottom	1.1	1.0	1.1	1.07

[1] This is a 50 ft tall standpipe.
Note: Data collected in July 2004.
ND - Non Detect

4. Summary of selected IDSE SMP sites:

Present the rationale for the selection of SMP sample sites in your system, as well as a schematic showing their location within the distribution system.

A description of the two SMP sites proposed for the Riverdale distribution system is given here. Each site is shown on a map of the distribution system in section I.2.

SMP Site #1 – Chosen to represent high TTHM levels. This site is located downstream of the standpipe on the western edge of town. It is located before the last group of connections in proximity to the end of the distribution system. Because water with high residence time from the upper portions of the tank is thought to be occasionally drawn into the distribution system during peak demand periods, this site has the potential for high TTHM levels.

SMP Site #2 – Chosen to represent high HAA5 levels. This site is a hose bib located upstream (prior to) of the storage tank on the western edge of the system. This site has average residence time within the distribution system, and chlorine residual is expected to be adequate (greater than 0.5 mg/L) to prevent biodegradation.

5. SMP Sample Schedule:

Annual Stage 1 DBPR monitoring is the only DBP monitoring that has been performed in the Riverdale system. As a result historic DBP data are available for only the month of August. DBP data is not available for any other months of the year, so water temperature data were reviewed to see which month of the year had the warmest water temperature. Our review of three years of finished water temperature data from the TCR sample site showed that distribution system water was warmest in August. Therefore, we concluded that August is the controlling month for the Riverdale distribution system. The following table summarizes our planned SMP sample dates and is based on sampling on the second Monday of the required month.

Proposed SMP Sample Schedule

Planned Sample Date
February 12, 2008
August 13, 2008

Dual sample sets will be collected from each of the 2 SMP sample sites on or close to the listed dates and analyzed for TTHM and HAA5 by a State-certified laboratory. Stage 1 DBPR compliance samples will be collected on the same day in August.

II. SMP RESULTS

1. Introduction:

The SMP was conducted in February and August 2008. The following table presents the planned SMP sample dates, the actual dates when samples were collected, and the reason for the one deviation from the plan.

Actual SMP Sample Schedule

Planned Sample Date	Actual Sample Date	Explanation
February 12, 2008	February 13, 2008	A blizzard prevented the operator from getting to the monitoring sites on February 12.
August 13, 2008	August 13, 2008	On schedule.

2. Summary of IDSE SMP data and Stage 1 DBPR compliance data:

All DBP results from the SMP and concurrent Stage 1 DBPR compliance monitoring are presented in the following table. The table presents the TTHM and HAA5 results for the SMP sample sites and the Stage 1 DBPR compliance site.

Riverdale SMP and Stage 1 DBPR Monitoring Results

	TTHM (µg/L)			HAA5 (µg/L)		
Monitoring Site	2/08	8/08	LRAA	2/08	8/08	LRAA
SMP Site #1 - Representative high TTHM	45	82	64	18	32	25
SMP Site #2 - Representative high HAA5	33	65	49	20	35	28
Stage 1 Maximum residence time	N/A	78	N/A	N/A	45	N/A

III. PROPOSED STAGE 2B COMPLIANCE MONITORING SITES

This section of the report should include a summary of your proposed Stage 2B monitoring sites including a schematic of the distribution system showing their locations, a discussion of the rationale for your selection of those sites, and a proposed monitoring schedule.

Stage 2B compliance sample sites were selected from the two SMP sample sites and the Stage 1 DBPR site. The selections were based on a comparison of the average TTHM and HAA5 values at the SMP sites and the August results for all three sites (two SMP and one Stage 1 DBPR sites). The following tables rank the sites based on their average TTHM and HAA5 values. The sites proposed as Stage 2B compliance sites are in bold text and shaded in the table. A schematic of the monitoring sites is presented in section III.2.

Proposed Stage 2B Compliance Monitoring Sites

TTHM			HAA5		
Site	**LRAA (µg/L)**	**August results (µg/L)**	**Site**	**LRAA (µg/L)**	**August results (µg/L**
SMP #1	**64**	**82**	**Stage 1**	**N/A**	**45**
Stage 1	N/A	78	SMP #2	28	35
SMP #2	49	65	SMP #1	25	32

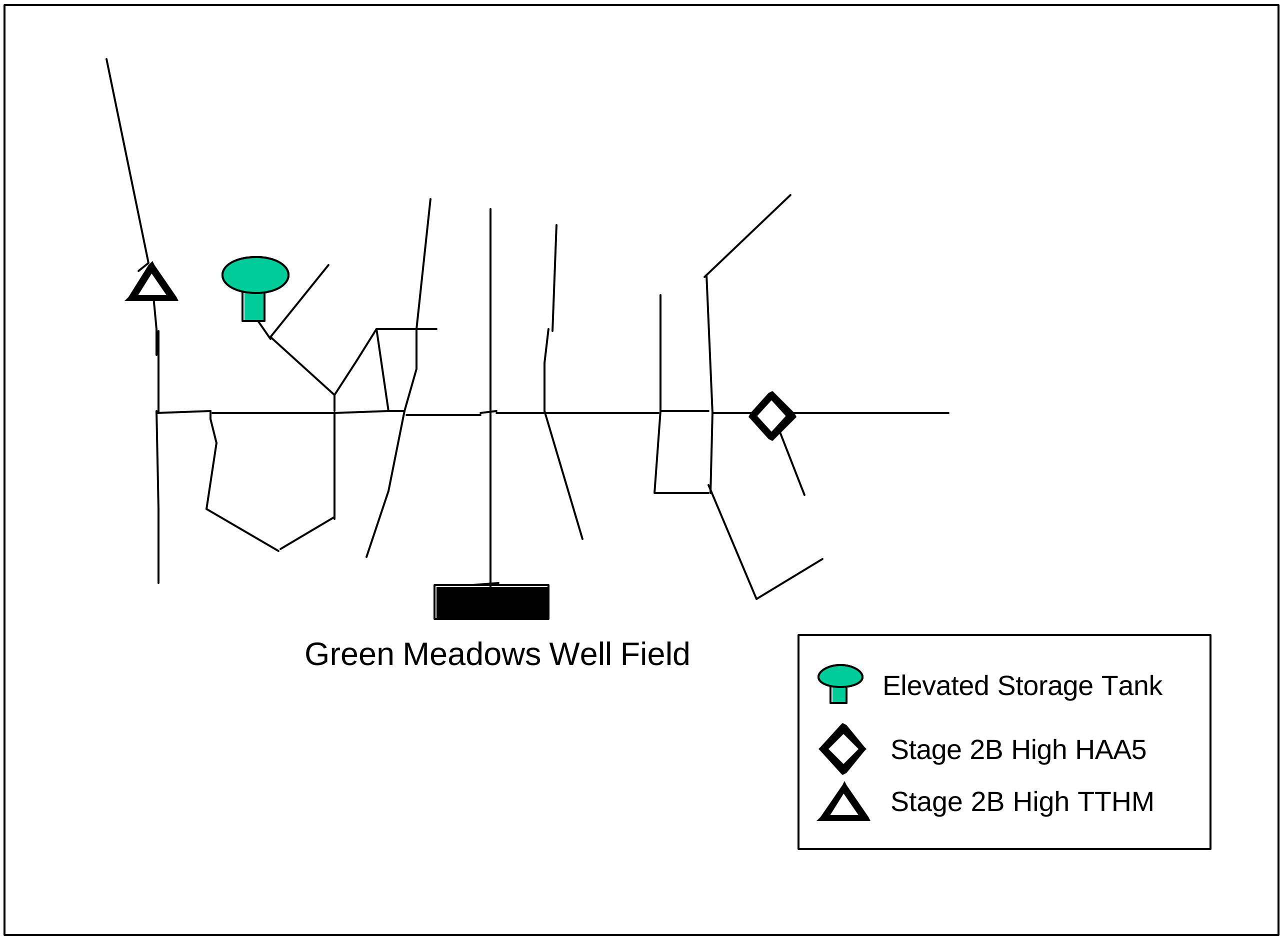
Bold text and shading identifies proposed Stage 2B compliance monitoring sites.

The proposed highest TTHM site is SMP #1. Of the three locations, SMP #1 has the highest average TTHM value as well as highest TTHM value during the peak temperature month (August).

The proposed highest HAA5 site is the Stage 1 DBPR site. This site has the highest August HAA5 value of the three sites.

Stage 2B sampling is proposed to occur in August (peak historical month for TTHM concentrations). TTHM samples will be collected at SMP #1 only, and HAA5 will be collected at the Stage 1 site only.

2. Schematic drawing of the distribution system with Stage 2 DBPR sites:



Appendix J

IDSE SMP Report for a 100 Percent Purchasing Surface Water System

This appendix is provided as an example IDSE report for surface water systems purchasing 100 percent of their water, serving 100,000 - 499,999 people, and opting to complete the Standard Monitoring Program (SMP).

Chapter 5 presents the detailed SMP requirements for these systems, and Chapter 8 provides guidance on selecting SMP sites and Stage 2B compliance monitoring sites based on SMP results. Chapter 8 also presents the IDSE reporting requirements. The application of the basic guidance on SMP site selection and Stage 2B compliance monitoring site selection is shown in this example, along with several instances of the use of best professional judgement being applied.

The italicized text within the appendix consists of comments and explanations and is not intended to represent the recommended content of an actual IDSE Report.

This page intentionally left blank.

Initial Distribution System Evaluation Report for Grove City

PWSID Number: US1111111

Address: 1234 Main Street
Grove City, US 99999

Contact Person: Ms. Margaret Doe, P.E.

Phone Number: 123-555-0000

Fax Number: 123-555-0001

Email Address: MDoe@ci.grovecity.us

System Type: Community, 100 % purchased SW

Population Served: 160,000

This page intentionally left blank.

I. SMP PLAN

1. System Description:

This section of the report should include a summary of typical system operating characteristics (and how they change on a seasonal basis if appropriate) explaining how sources are used to meet system demands, where high water age is expected to occur, and any special aspects of operation that could affect DBP concentrations in the distribution system.

General system characteristics:

Service area: Grove City plus surrounding suburban areas
Production: Annual average daily demand 15 MGD

Source Water Information:

The wholesalers do not provide us with raw water quality data, but our purchasing agreements require water quality at our city's entry points to meet State and federal drinking water quality standards.

Entry points and service areas under the influence of each entry point:
(Entry points should be tied to source(s) and typical flows noted)

Entry points: Purchase approximately 50 percent (7.5 mgd average) from Big City
Purchase remaining 50 percent (7.5 mgd average) from New City
Both sources provide treated surface water and are used year round.

Customers located in the Cypressville, Cedarville, Poplarville, and north downtown generally receive water from Big City

Customers located in the Industrial Park area, Oakville, Pineville, and south downtown generally receive water from New City

Customers located in the Weeping Willow Community, Appleville, and central downtown generally receive a mixture of water from both plants

Treatment Provided:

Big City – conventional treatment followed by UF
New City – conventional treatment
Primary and residual disinfection: chlorine/chloramines at both sources.

<u>Description of distribution system:</u>

Distribution system (estimated length of lines and range of diameter):
About 400 miles, 4" - 56" (approximately 20 MG carrying capacity)

5 storage tanks of 10 MG total capacity
- 1 ground tank 4 MG capacity
- 4 elevated tanks 6 MG total capacity (1.5 MG each)

The average residence time of water in the distribution system is six to eight days.

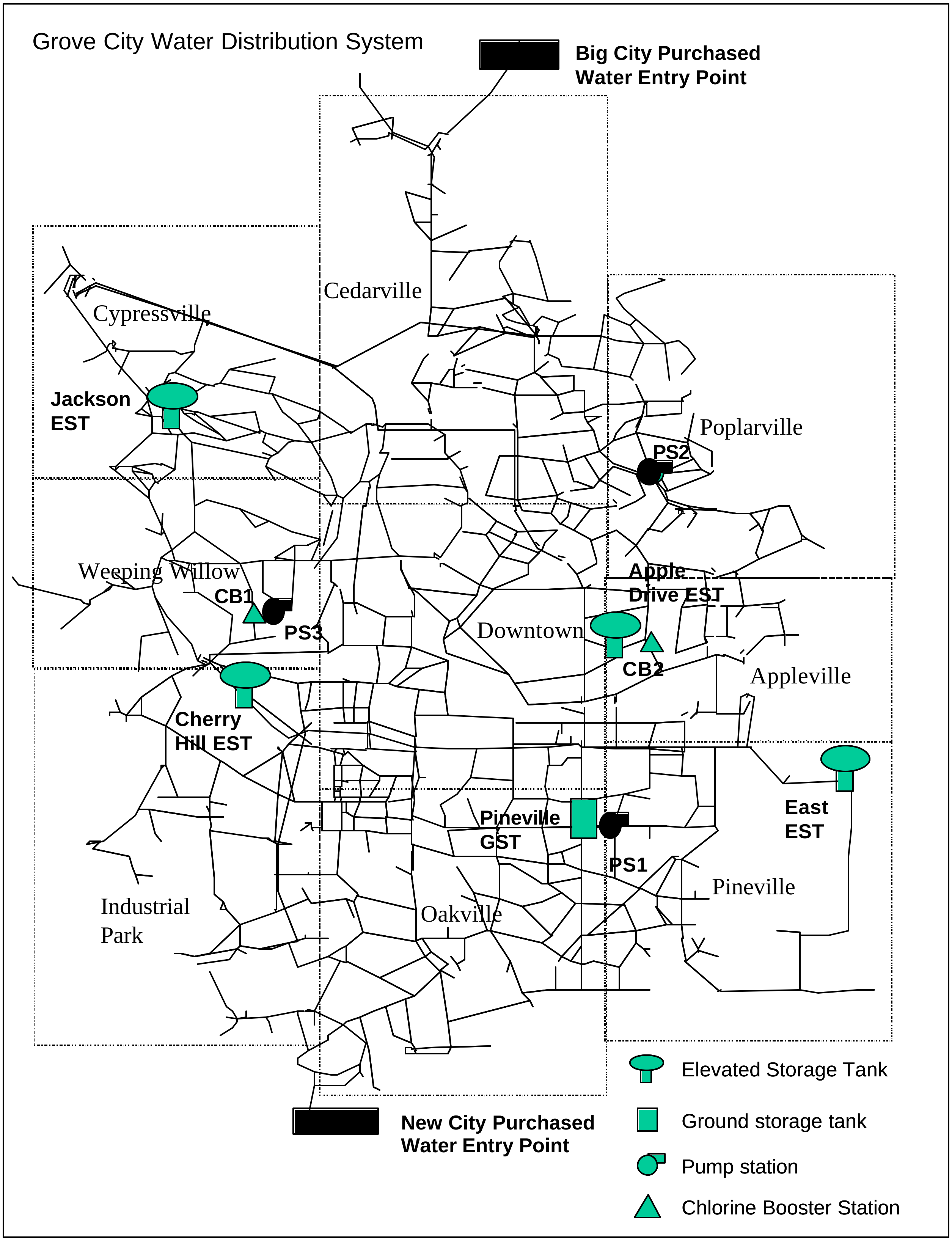
Pump stations:
Station #1 is located at the ground storage tank (in Pineville). This pump is primarily used during peak demands and low pressure situations. The pump is timed to turn on in the morning and evening during peak demand, and when the pressure drops below 40 psi at a point downstream of the pump station.

Stations #2 and #3. These pumps are used to boost system pressure when the pressure in the areas downstream of these pumps (Poplarville and Weeping Willow, respectively) drops below 40 psi.

Booster chloramination facilities:
Facility #1 is located on Cherry Hill Ave. (downstream of the Cherry Hill storage tank at pump station #3 in Weeping Willow). This facility is occasionally used during the summer when remote locations downstream of the booster chloramination facility lose total chlorine residual.

Facility #2 is located at the intersection of Second Ave. and 11th St. (in a mixing zone) in an area of the distribution system where total chlorine residuals are frequently low.

2. Schematic drawing of the distribution system:



3. SMP monitoring requirements:

The Grove City system serves 160,000 people and purchases only surface water. Therefore, a total of 24 SMP sample sites are required to be sampled approximately every 60 days for one year (6 dual sample sets per site) for TTHM and HAA5.

Required SMP Sample Sites

Site Criteria	Number of Sample Sites
Near entry to the distribution system	2[1]
Average residence time	6
Representative of high HAA5	7
Representative of high TTHM	9

[1] The Stage 2 rule requires 4 near-entry point SMP sites for our size of system. However, because we only have two consecutive entry points, the other two were divided among high TTHM and HAA5 sites.

Available Data:

Report all data that helped in site selection. For this example, tables are presented with limited data for Stage 1 DBPR sample sites and the sites chosen as SMP sample locations. Your report should include data for all sites that were considered as candidates for SMP sites. If you have bromide, TOC, or HPC data, these may be helpful for justifying Stage 2B site selections.

Total chlorine residual and HPC data were available at our Total Coliform Rule and Stage 1 DBPR sample sites. The chlorine data for the summer months of June, July, August, and September were reviewed, and monthly averages and an overall average were calculated. These data are presented in Table J.1. The SMP sample site numbering and type are also provided for reference.

Quarterly HPC data were available for the same year and at the same sites as the total chlorine data. The four results for each site were averaged. The monthly results and overall average values are presented in Table J.2.

Table J.1 Grove City Distribution System—Total Chlorine Residual Data

Sample Site ID #	Source/ Plant	Stage 1 Type	SMP Site #	SMP Type	Total Chlorine Residual (mg/L)				
					June	July	Aug.	Sept.	Mean
TCR #9	NC		1	E	3.6	3.4	3.5	3.6	3.5
TCR #11	NC		2	A	2.9	2.7	3.2	2.4	2.5
TCR #22	NC		3	A	2.3	2.1	2.3	2.4	2.3
TCR #3	NC		4	A	2.4	2.7	2.3	2.5	2.5
TCR #46	NC		5	H	2.1	1.7	1.9	2.0	1.9
TCR #5	NC		6	H	1.0	1.2	1.1	1.0	1.1
TCR #6	NC		7	H	1.8	1.6	1.6	1.6	1.7
TCR #78	NC		8	T	0.9	0.9	1.2	0.9	1.0
TCR #81	NC		9	T	1.0	1.1	1.3	1.1	1.1
TCR #39	NC		10	T	1.7	1.8	1.7	1.7	1.7
TCR #10	NC		11	T	0.6	0.6	0.9	0.6	0.7
TCR #1	BC		12	E	3.4	3.2	3.7	2.9	3.3
TCR #86	BC		13	A	2.1	2.1	2.4	2.0	2.2
TCR #21	BC		14	A	2.0	1.8	2.0	1.9	1.9
TCR #35	BC		15	A	2.2	1.9	2.5	2.3	2.2
TCR #13	BC		16	H	2.0	2.3	1.9	2.4	2.2
TCR #49	BC		17	H	1.5	1.2	1.8	1.6	1.5
TCR #65	BC		18	H	1.9	2.2	1.8	2.3	2.1
TCR #16	MIX		19	T	2.5	2.6	2.8	2.9	2.7
TCR #51	BC		20	T	0.9	1.3	0.9	1.0	1.0
TCR #72	MIX		21	T	1.9	2.0	1.9	1.9	1.9
TCR #71	MIX		22	H	2.0	1.8	1.6	1.7	1.8
TCR #20	MIX		23	T	0.7	1.1	0.7	0.8	0.8
TCR #58	MIX		24	T	0.5	0.6	0.8	0.6	0.6
Stg. 1 #1	BC	Avg			2.2	2.5	2.4	2.7	2.5
Stg. 1 #2	BC	Avg			2.1	2.2	2.7	2.3	2.3
Stg. 1 #3	MIX	Avg			1.6	1.7	1.7	1.9	1.7
Stg. 1 #4	BC	Max			0.8	1.1	0.7	0.8	0.9
Stg. 1 #5	NC	Avg			2.5	2.6	2.5	2.0	2.4
Stg. 1 #6	NC	Avg			2.4	2.2	2.7	2.5	2.5
Stg. 1 #7	MIX	Avg			1.4	2.0	1.7	2.0	1.8
Stg. 1 #8	NC	Max			0.7	1.7	0.8	1.4	1.0

MIX - Mixing Zone
NC - New City Source
BC - Big City Source

TCR - Total Coliform Rule
Stg. 1 - Stage 1 DBPR

E - Near Entry Point
A - Average Residence Time
T - Representative High TTHM
H - Representative High HAA5

Table J.2 Grove City Distribution System—Heterotrophic Plate Count (HPC) Data

Sample Site ID #	Source/ Plant	Stage 1 Type	SMP Site #	SMP Type	HPC (cfu/mL)				
					June	July	Aug.	Sept.	Mean
TCR #9	NC		1	E	12	8	34	12	17
TCR #11	NC		2	A	78	86	384	364	228
TCR #22	NC		3	A	35	62	147	92	84
TCR #3	NC		4	A	43	34	156	224	114
TCR #46	NC		5	H	34	76	97	89	74
TCR #5	NC		6	H	54	65	87	97	76
TCR #6	NC		7	H	35	43	64	45	47
TCR #78	NC		8	T	68	175	399	375	254
TCR #81	NC		9	T	151	273	164	354	235
TCR #39	NC		10	T	43	67	125	102	84
TCR #10	NC		11	T	156	278	169	359	240
TCR #1	BC		12	E	67	14	35	42	40
TCR #86	BC		13	A	43	34	156	224	114
TCR #21	BC		14	A	54	65	573	65	189
TCR #35	BC		15	A	56	72	202	147	119
TCR #13	BC		16	H	53	64	94	123	83
TCR #49	BC		17	H	50	34	113	63	65
TCR #65	BC		18	H	35	43	64	45	47
TCR #16	MIX		19	T	34	76	97	89	74
TCR #51	BC		20	T	69	43	37	43	48
TCR #72	MIX		21	T	54	65	573	65	189
TCR #71	MIX		22	H	66	53	153	53	81
TCR #20	MIX		23	T	70	212	356	332	242
TCR #58	MIX		24	T	233	214	456	546	362
Stg. 1 #1	BC	Avg			56	42	345	276	180
Stg. 1 #2	BC	Avg			82	136	146	246	152
Stg. 1 #3	MIX	Avg			280	163	446	263	288
Stg. 1 #4	BC	Max			140	215	557	615	382
Stg. 1 #5	NC	Avg			50	42	223	522	209
Stg. 1 #6	NC	Avg			53	42	84	72	63
Stg. 1 #7	MIX	Avg			140	66	364	236	201
Stg. 1 #8	NC	Max			196	45	653	425	330

MIX - Mixing Zone
NC - New City Source
BC - Big City Source

TCR - Total Coliform Rule
Stg. 1 - Stage 1 DBPR

E - Near Entry Point
A - Average Residence Time
T - Representative High TTHM
H - Representative High HAA5

<u>4. Summary of selected SMP sample sites:</u>

Present the rationale for the selection of the IDSE sampling sites, as well as a schematic showing their location within the distribution system.

Sampling sites were chosen to represent diverse geographical areas of the distribution system. Each site is shown on the map of the distribution system in section I.6. Residual total chlorine (Table J.1) and HPC data (Table J.2) were considered in the selection of SMP monitoring sites.

<u>SMP Site #1</u> – Entry point to the distribution system for New City supply. This site is located where the first group of customers receives water.

<u>SMP Site #2</u> – Represents average residence time of water leaving New City. Based on total chlorine monitoring results at TCR sample sites, we identified the areas within the system where total chlorine levels dropped by approximately 50 percent of the total drop in residual seen in the area supplied by New City. The average initial concentration (at SMP #1) was 3.5 mg/L. The average residual at SMP #11 (the site with the lowest residual and solely under the influence of New City) is 0.7 mg/L. Therefore, the average drop in residual across the system is approximately 2.8 mg/L; half of that drop is 1.4 mg/L. Sites with residual concentrations near 2.1 mg/L were considered to be approximate average residence time sites. The average residual at this site is 2.5 mg/L. There are no storage facilities between the entry point and this site.

<u>SMP Site #3</u> – Represents average residence time of water received from New City. Water at this site has an average total chlorine residual of 2.3 mg/L. Based on the rationale presented in the discussion of site #2, this site was determined to be an approximate average residence time site.

<u>SMP Site #4</u> – Represents average residence time of water entering from New City. Water at this site has an average total chlorine residual of 2.5 mg/L. Based on the rationale presented in the discussion of site #2, this site was determined to be an approximate average residence time site.

<u>SMP Site #5</u> – Represents high HAA5 levels. Sample site is in an area approaching the perimeter of the distribution system. Water in this area is primarily from the New City. Total chlorine residual at this site ranges between 1.7 and 2.1 mg/L, and the heterotrophic plate count is consistently below 100 cfu per mL year round.

<u>SMP Site #6</u> – Represents high HAA5 levels. This site is at the edge of the mixing zone between the New City and Big City influence areas. Total chlorine residual levels ranged between 1.0 and 1.2 mg/L at this site, and the heterotrophic plate count never exceeded 100 cfu per mL.

<u>SMP Site #7</u> – Represents high HAA5 levels. This site is a hose bib located at a convenience store. Total chlorine residual levels ranged between 1.6 and 1.8 mg/L at this site, and the heterotrophic plate count never exceeded 100 cfu per mL.

SMP Site #8 – Represents high TTHM levels. This sampling site is the western edge of the city. Total chlorine residuals at this site are generally very low.

SMP Site #9 – Represents high TTHM levels. This sampling site is believed to receive water from the Pineville Storage tank (a 4 MG ground tank) during high demand periods and is at the entrance to a small subdivision cul-de-sac in the Oakville community. Chlorine residuals at this site are generally low. The sample site is near the first house on the cul-de-sac (which has 12 homes total).

SMP Site #10 – Represents high TTHM levels. This site is located upstream of the Stage 1 DBPR monitoring site #7. Both are used for routine Total Coliform Rule and chlorine residual monitoring. We have over 7 years of data from this site. This site is located near the predicted edge of the mixing zone where chlorine residual measurements indicate there may be a hydraulic dead end. Water at this site is generally from the New City supply, although specific conductivity data show that some mixed zone water may also influence this site.

SMP Site #11 – Represents high TTHM levels. This site has been problematic in the past due to positive total coliform test results, very low total chlorine residuals, high heterotrophic plate count results, and odor complaints. A 4-inch blow-off was installed downstream of this site, but it continues to have periodic poor water quality. Water in this area is from the New City supply.

SMP Site #12 – Entry point to the distribution system for the Big City supply. This site is located near the first group of customers that receive water from the Big City supply.

SMP Site #13 – Represents average residence time of water entering from Big City. Based on total chlorine monitoring results at TCR sample sites, we identified the areas within the system where total chlorine levels dropped by approximately 50 percent of the total drop in residual seen in the area supplied by Big City. The average initial concentration (at SMP #1) was 3.3 mg/L. The average residual at site #24 (the site with the lowest residual and solely under the influence of New City) is 0.6 mg/L. Therefore, the average drop in residual across the system is approximately 2.7 mg/L; half of that drop is 1.3 to 1.4 mg/L. Sites with residual concentrations near 2.0 mg/L were considered to be approximate average residence time sites. The average total chlorine residual at this site is 2.2

SMP Site #14 – Represents average residence time of water entering from Big City. Water at this site has an average total chlorine residual of 1.9 mg/L. Based on the rationale presented in the discussion of site #13, this site was determined to be an approximate average residence time site.

SMP Site # 15 – Represents average residence time for the Big City water supply. This sampling site is in the southern edge of Cedarville subdivision. Water at this site has an average total chlorine residual of 2.2 mg/L. Based on the rationale presented in the discussion of site #13, this site was determined to be an approximate average residence time site.

<u>SMP Site #16</u> – Represents high HAA5 levels. Our Stage 1 DBPR results indicate the high HAA5 concentrations move around our system depending on the season and proportion of water supplies from New City and Big City, especially in the areas served by the Big City.

<u>SMP Site #17</u> – Represents high HAA5 levels for the Big City supply. At this site, the water age is greater than average (evidenced by average total chlorine residual of 1.5), the total chlorine residual was never below 1.8 mg/L and the heterotrophic count plate is usually low (below 100 with one exception in August).

<u>SMP Site #18</u> – Represents high HAA5 levels for the Big City supply. At this site, the water age is approximately equal to the system average (evidenced by average total chlorine residual of 2.1), the total chlorine residual was never below 1.9 mg/L and the heterotrophic count plate is usually low (below 100).

<u>SMP Site #19</u> – Represents high TTHM levels. This sample site is located in a zone of the distribution system that has been recently developed. This connection is located downstream from a chlorine booster station. Total chlorine residuals are normally in the 2.5 to 2.9 mg/L range. Water in this area is generally a mix of water from the New City and Big City supplies.

<u>SMP Site #20</u> – Represents high TTHM levels. This site is downstream from the Jackson Storage Tank in Cypressville, a 1.5 million gallon elevated storage tank. There are often low chlorine residuals in the areas downstream of this tank.

<u>SMP Site #21</u> – Represents high TTHM levels. This sampling site is in the mixed zone before the last group of connections near the end of the distribution system. This area receives water from the Cherry Hill Storage Tank and water that bypasses the tank. Water from this area can vary greatly in the percentages of New City and Big City water.

<u>SMP Site #22</u> – Represents high HAA5 levels. At this site, the water age is believed to be greater than average because it is within the mixing zone, but the total chlorine residual is never below 1.6 mg/L and the heterotrophic count plate is usually low (below 100 cfu/mL with one exception in August).

<u>SMP Site #23</u> – Represents high TTHM levels. This sampling site is in the mixed zone. Total chlorine residuals range from 0.7 to 1.1 mg/L which is well below the system average. This area receives water from the Pineville ground storage tank.

<u>SMP Site #24</u> – Represents high TTHM levels. This sampling site is in the mixed zone. It has total chlorine residuals that range from 0.5 to 0.8 mg/L which is well below the system average.

5. SMP Sample Schedule:

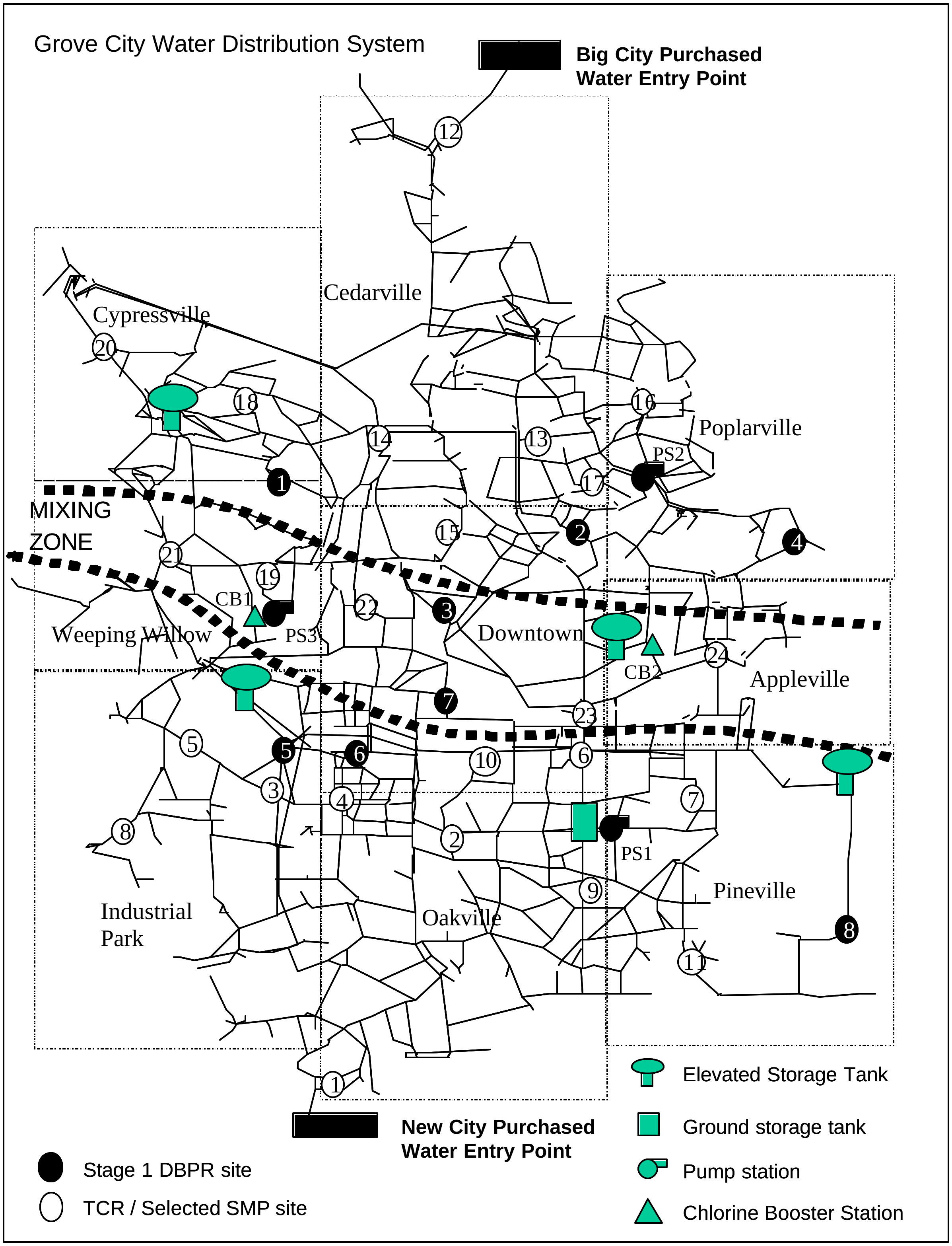
Because the quarterly Stage 1 DBPR monitoring is the only DBP monitoring that has been performed in the Grove City system, historic DBP data is available for only the months of January, April, July, and October. July has regularly had the highest DBP levels, but no DBP data is available for the other summer months. As a result, we also reviewed finished water temperature in two years of TCR sampling records and determined our peak month for distribution system water temperature is August. But, we also found that July's average distribution system water temperature for the two years reviewed was only 0.5º C less. Based on the historic DBP data and minimal difference in average water temperature, we concluded July is the controlling month for the Elm City distribution system. The following table summarizes our planned SMP sample dates and is based on collection of our samples on the second Monday of the month.

Proposed SMP Sample Schedule

Planned Sample Date
November 8, 2005
January 10, 2006
March 14, 2006
May 9, 2006
July 11, 2006
September 12, 2006

Dual sample sets will be collected from each of the 24 SMP sample sites on or close to the listed dates and analyzed for TTHM and HAA5 by a State-certified laboratory.

6. Map of the distribution system showing major transmission mains, numbered Stage 1 DBPR compliance sites, and numbered SMP sample sites:



II. SMP RESULTS

1. Introduction:

The SMP was conducted between November 2005 and September 2006. The following table summarizes our planned SMP sample dates, the actual dates when samples were collected, and the reasons for deviations from the plan.

Actual SMP Sample Schedule

Planned Sample Date	Actual Sample Date	Explanation
November 8, 2005	November 8, 2005	On schedule
January 10, 2006	January 10, 2006	On schedule
March 14, 2006	March 14, 2006	On schedule
May 9, 2006	May 9, 2006	On schedule
July 11, 2006	July 11, 2006	On schedule
September 12, 2006	September 14, 2006	Flooding closed many of the roads in Grove City, making many sample sites inaccesible until September 14.

2. Summary of IDSE SMP data and Stage 1 DBPR compliance data:

All DBP results from the SMP and concurrent Stage 1 DBPR compliance monitoring are presented in this section. The first table presents the DBP results for the SMP sample sites, organized by plant, then in order of highest to lowest TTHM LRAA. The second table presents the DBP results for the Stage 1 DBPR compliance sample sites for the period from November 2005 to August 2006. Sites proposed as Stage 2B compliance monitoring locations are shaded within the tables.

Grove City—IDSE SMP Monitoring Results

SMP Site #	Site Type	TTHM (ug/L) Data[1]	TTHM (ug/L) LRAA	HAA5 (ug/L) Data[1]	HAA5 (ug/L) LRAA
1	entry point	36, 42, 30, 25, 38, 28	33	50, 44, 43, 47, 48, 38	45
12	entry point	30, 32, 39, 40, 32, 28	29	31, 29, 38, 48, 51, 45	43
13	average residence time	42, 34, 52, 57, 62, 51	50	23, 56, 40, 52, 40, 28	40
2	average residence time	54, 39, 42, 56, 60, 42	49	22, 29, 36, 40, 41, 30	33
4	average residence time	51, 42, 50, 39, 50, 42	47	19, 26, 28, 31, 26, 22	25
14	average residence time	47, 40, 52, 43, 51, 41	46	14, 20, 21, 23, 29, 19	21
15	average residence time	40, 45, 45, 48, 52, 46	46	41, 32, 45, 40, 35, 43	39
3	average residence time	42, 39, 53, 43, 49, 40	44	20, 25, 25, 29, 27, 19	24
6	**high HAA5**	**36, 41, 43, 39 49, 45**	**42**	**60, 58, 68, 57, 68, 55**	**61**
16	**high HAA5**	**52, 35, 46, 42, 50, 38**	**44**	**56, 44, 65, 50, 50, 58**	**54**
17	**high HAA5**	**50, 33, 44, 40, 48, 36**	**42**	**53, 42, 64, 48, 49, 55**	**52**
7	high HAA5	35, 30, 42, 44, 44, 25	37	37, 43, 55, 57, 50, 42	47
5	high HAA5	33, 29, 41, 42, 44, 22	35	36, 43, 52, 51, 48, 38	45
18	high HAA5	35, 31, 47, 38, 49, 30	39	37, 42, 48, 50, 41, 35	42
22	high HAA5	35, 29, 47, 37, 47, 27	37	36, 40, 46, 48, 40, 34	41
11	**high TTHM**	**68, 59, 78, 76, 75, 65**	**70**	**42, 39, 47, 46, 40, 49**	**44**
8	**high TTHM**	**62, 60, 65, 71, 74, 72**	**67**	**42, 40, 33, 38, 46, 30**	**38**
10	**high TTHM**	**68, 62, 54, 65, 72, 70**	**65**	**39, 45, 28, 33, 40, 32**	**36**
23	**high TTHM**	**67, 59, 58, 49, 71, 75**	**63**	**32, 35, 27, 30, 39, 29**	**32**
21	high TTHM	69, 56, 72, 59, 71, 55	63	19, 25, 39, 29, 21, 38	29
20	**high TTHM**	**65, 61, 54, 50, 69, 71**	**62**	**37, 41, 29, 30, 41, 29**	**35**
9	high TTHM	51, 56, 69, 58, 67, 52	59	31, 38, 37,40, 32, 45	37
24	high TTHM	50, 51, 55, 53, 62, 65	56	37, 39, 29, 28, 39, 27	33
19	high TTHM	56, 50, 55, 51, 61, 45	53	42, 30, 43, 38, 34, 42	38

[1]Data obtained from sampling every 60 days are listed in order for November, January, March, May, July, and September (as required for a surface water supply $\geq$10,000).
Note: **Bold text and shading** identifies proposed Stage 2 DBPR compliance sites.

Grove City—Stage 1 DBPR Compliance Monitoring Results

Stage 1 Site #	Site Type	TTHM (ug/L)		HAA5 (ug/L)	
		Data[1]	LRAA	Data[1]	LRAA
Stg. 1 #4	**Maximum**	**64, 68, 83, 74**	**72**	**21, 25, 26, 28**	**25**
Stg. 1 #8	Maximum	61, 48, 56, 71	59	19, 22, 37, 30	27
Stg. 1 #2	**Average**	**38, 42, 52, 62**	**49**	**50, 62, 64, 65**	**59**
Stg. 1 #1	**Average**	**45, 34, 56, 62**	**49**	**24, 32, 43, 45**	**36**
Stg. 1 #6	Average	47, 49, 39, 52	47	22, 30, 39, 41	33
Stg. 1 #3	**Average**	**36, 42, 45, 45**	**42**	**47, 50, 55, 56**	**52**
Stg. 1 #5	Average	44, 20, 62, 42	42	34, 45, 33, 41	38
Stg. 1 #7	Average	41, 22, 50, 59	43	32, 46, 59, 52	47

[1]Data listed in order for October, January, April, and July quarterly sampling.

Note: **Bold text and shading** identifies proposed Stage 2B compliance sites.

III. PROPOSED STAGE 2B COMPLIANCE MONITORING SITES

1. Site Summary:

A total of 12 Stage 2B compliance monitoring sites were selected from the Stage 1 DBPR and SMP sites, as shown in the previous tables and as summarized in the following table.

Stage 2B Proposed Compliance Monitoring Sites

Stage 2B Compliance Sites		
Site #	Type	Previous Sample Site ID
1	Average	Stg. 1 #2
2	Average	Stg. 1 #3
3	Average	Stg. 1 #1
4	High HAA5	SMP #6
5	High HAA5	SMP #16
6	High HAA5	SMP #17
7	High TTHM	Stg. 1 #4
8	High TTHM	SMP #11
9	High TTHM	SMP #8
10	High TTHM	SMP #10
11	High TTHM	SMP #23
12	High TTHM	SMP #20

2. Justification of Site Selections:

The reasons for the selection of the 12 sites for Stage 2B monitoring are:

1. **Average Residence Time Sites –** The Stage 2 DBPR required us to select three average residence time sites from among our existing Stage 1 DBPR monitoring sites. The sites were required to be selected based on alternating highest TTHM LRAA and HAA5 LRAA. Because we have three average residence time sites, we ultimately ended up selecting two based on highest TTHM LRAA and one based on highest HAA5 LRAA. Stage 1 DBPR average residence time sites #2 and #1 had the highest TTHM LRAA among Stage 1 DBPR average residence time sites. Stage 1 DBPR site #3 had the highest HAA5 LRAA among the Stage 1 average residence time sites.

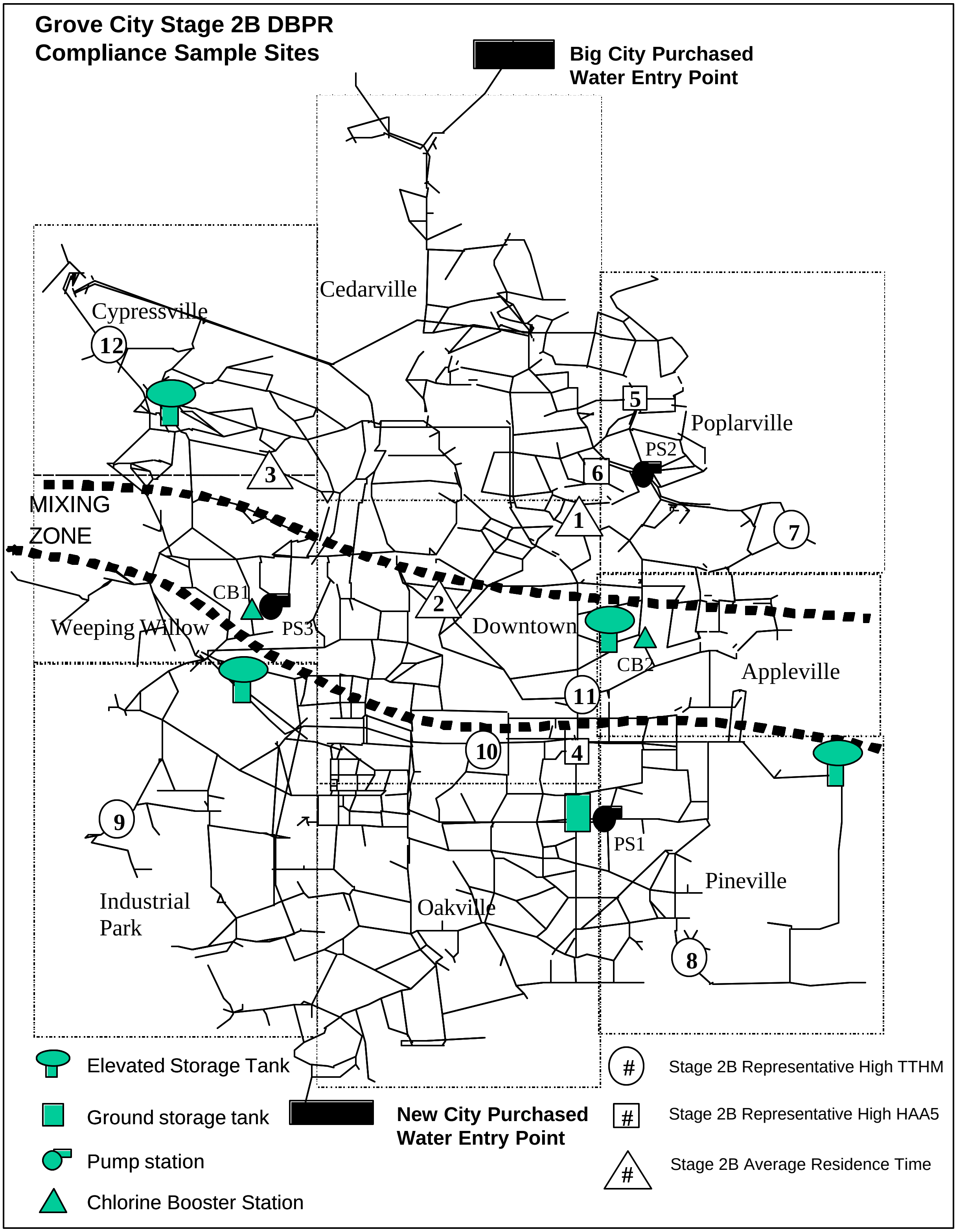
2. **Representative High HAA5 Site –** The three highest HAA5 LRAA values occur at SMP site #6 and #16, and #17. Therefore, these three sites were designated as Stage 2B sites (numbers 4, 5, and 6).

3. **Representative High TTHM Sites –** The six highest TTHM LRAA values occur at SMP Site #11, #8, #10, #23, and #20, and Stage 1 DBPR Site #4. Therefore, these six sites were designated as Stage 2B sites. SMP site #20 and #21 actually had the same TTHM LRAA, but site #20 provided better geographic coverage and was selected as a proposed Stage 2B monitoring site.

3. Proposed Stage 2B Compliance Monitoring Schedule:

Stage 2B compliance monitoring will be scheduled for January, April, July, and October, the same as Stage 1 DBPR and Stage 2A DBPR sampling, for consistency and because the difference in distribution system water temperature between July and August is minimal (average 0.5º C higher in August, based on a review of 2 years of TCR sampling records).

4. Map of Proposed Stage 2B Compliance Monitoring Sites:



This page intentionally left blank.

Appendix K

IDSE System Specific Study Using a Hydraulic Model

This appendix is provided as an example IDSE report for producing surface water systems serving least 10,000 people and opting to complete a System Specific Study (SSS) using a water distribution system model.

Chapter 3 presents detailed guidance on the requirements for performing an SSS with a water distribution system model. Chapter 5 presents the detailed SMP requirements for these systems. Chapter 3 also provides guidance on selecting SMP sites and Stage 2B compliance monitoring sites based on SSS data, as well as IDSE reporting requirements. The application of the basic guidance on SMP site selection and Stage 2B compliance monitoring site selection is shown in this example, along with several instances of the use of best professional judgement being applied.

The italicized text within the appendix consists of comments and explanations and is not intended to represent the recommended content of an actual IDSE Report.

This page intentionally left blank.

Initial Distribution System Evaluation Report for Big City

PWSID Number: US1111111

Address: 1234 Main Street
Big City, US 99999

Contact Person: Mr. John Smith, P.E.

Phone Number: 123-555-0000

Fax Number: 123-555-0001

Email Address: jsmith@ci.bigcity.us

System Type: Community, surface water

Population Served: 55,000

This page intentionally left blank.

1. System Description:

This section of the report includes a summary of typical system operating characteristics (and how they change on a seasonal basis if appropriate) explaining how sources are used to meet system demands, where high water age is expected to occur, and any special aspects of operation that could affect DBP concentrations in the distribution system. Information about water treatment processes and source water quality data should also be part of this section, including a description of water treatment, actual residence times within the water treatment plant and the distribution system.

General system characteristics:

Service area: Big City plus surrounding suburban areas
Production: Annual average daily demand 7 MGD

Source Water Information:

Adams Reservoir (surface water) water quality:
- pH: from 7.0 to 8.0
- Alkalinity: from 62 to 88 mg/L as $CaCO_3$
- TOC: from 3.2 to 6.8 mg/L as C

Lincoln River (surface water) water quality:
- pH: from 6.8 to 7.9
- Alkalinity: from 77 to 94 mg/L as $CaCO_3$
- TOC: from 1.6 to 4.4 mg/L as C

Entry points and service areas under the influence of each entry point:
(Entry points should be tied to source(s) and typical flows noted)

Entry points: Adams Plant – serves the northern half of the city
Lincoln Plant – serves the southern half of the city

Treatment Provided:

Adams Plant is a 6 MGD plant located on the northern edge of the city. It draws water from Adams Reservoir. The plant utilizes coagulation (with ferric chloride), flocculation, sedimentation, and dual media filters (filter loading rates are approximately 4 gpm/sf).

Lincoln Plant is an 8 MGD plant located in the southern part of the system and draws water from Lincoln River. The treatment process is identical to that of the Adams Plant, except that the Lincoln Plant also includes GAC filters following dual media filtration to enhance TOC removal. The Lincoln River is prone to rapid changes in TOC, and the GAC was installed as an extra barrier to prevent significant DBP formation in the distribution system.

Primary and residual disinfection: Chlorine/chloramines at both plants.

<u>Description of distribution system:</u>

Distribution system (estimated length of lines and range of diameter):

About 300 miles, 4" - 36"

Lined and unlined cast iron pipe, ductile iron pipe, and plastic pipe

4 storage tanks of 9 MG total capacity

1 ground tank 4 MG capacity

2 elevated tanks each with 2 MG capacity

1 elevated tank with 1 MG capacity

The average residence time of water in the distribution system is approximately two days.

Pump stations:

A pump station is located at the north tank (4 MG ground storage tank). This pump is primarily used during peak demands and low pressure situations. The pump is timed to turn on in the morning and evening during peak demand, and when the pressure drops below 40 psi at a point downstream of the pump station.

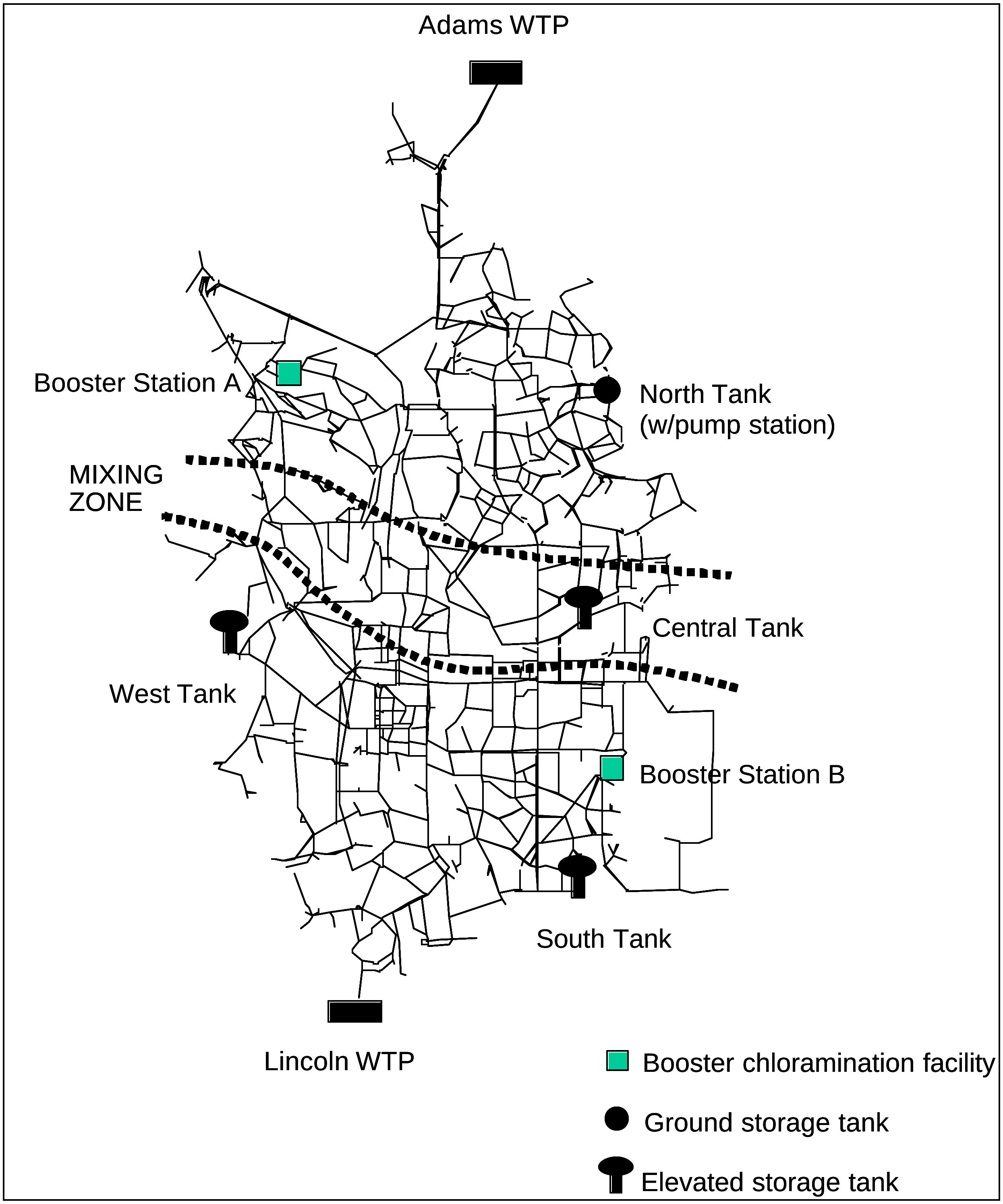
Booster chloramination facilities:

Booster Facility A is located in the northwestern part of the city. This facility is occasionally used during the summer when total chlorine residuals at remote locations downstream of the booster facility cannot be maintained.

Booster Facility B is located in the southeastern part of the city, where total chloramine residuals have historically been low.

A schematic of the distribution system is presented in the following section.

2. Schematic of the distribution system:



3. Summary of SSS requirements:

Big City has extensive experience with water distribution system modeling. To select Stage 2B compliance monitoring sites, the city has performed a System Specific Study (SSS) based on its water distribution system model, data from one round of new DBP sampling, and data from Stage 1 DBPR compliance monitoring.

To confirm model results, we conducted one round of DBP sampling at sites equivalent to those that would be selected under the SMP requirements for large, subpart H systems. A summary of these requirements is presented in the following table. The methodology by which these sites were chosen is presented in section 5.

Additional DBP Sampling Site Criteria[1]

Site Criteria	Number of Sample Sites	
	Adams WTP Influence Zone	Lincoln WTP Influence Zone
Near entry to the distribution system	2	2
Average residence time	2	2
Representative of high TTHM	2	2
Representative of high HAA5	2	2

1 These sites were allocated based on SMP requirements for a system of our size and source water type and practicing similar disinfection methods.

4. Description of Hydraulic Model

The hydraulic model for Big City includes all 8-inch and larger pipes and also includes 6-inch pipes for the remote areas of the distribution system. Approximately 60 percent of the total pipe length in the distribution system is included in the model. The open/closed status of all four storage tanks and the on/off status of the pump station at the North Tank have been modeled. There are two control valves in the distribution system, but these do not significantly affect the water flow through the distribution system. Therefore, these control valves have not been modeled.

Water demand has been assigned to approximately 60 percent of the nodes in the model. In areas where there are no water users at the dead-end of a pipe segment, a very small nominal demand was assigned to the end nodes so that water ages at the dead ends could be calculated by the modeling software. Summer and winter average demand data were available for residential customers and large commercial and industrial customers. The estimated water loss in the system is about 10 percent and this was accounted for in the model. Based on the master meter flows, tank levels, and customer meter readings, a diurnal (24-hour) demand pattern was derived and was applied to the residential, commercial, and industrial customers. The inclusion of diurnal demand patterns allows the hydraulic model to be run in the extended period simulation (EPS) mode.

A major calibration effort was performed when the model was developed in 1998. At that time the model was calibrated for average summer and maximum day conditions. Since the last calibration, no significant changes have been made to the distribution system that could change the system hydraulics. The calibration program included extensive C-factor tests conducted over the previous 10 years and comparisons of modeled and measured pressures throughout the system. The model predicted pressures were within ± 3 psi of the field measured pressures at 70 percent of the readings. This is consistent with calibration guidelines for hydraulic models to be used for water quality purposes (Walski, et al., "Perspectives in Calibration," Current Methods, 1:1:21, Haested Press, 2001).

5. Summary of the SSS methodology:

Summarize the methodology used to conduct the SSS, including the rationale for the selection of sites equivalent to the sample sites required for the Standard Monitoring Program (SMP).

The hydraulic model was applied in a variety of ways to understand the flow of water through the distribution system and guide the selection of monitoring sites that reflected the selection criteria outlined in Chapter 3 of the IDSE guidance manual. For this SSS, 16 sites were selected that meet the criteria required for the SMP of a system of a similar size and source water type providing similar disinfection (see section 3).

The model was run in the extended period simulation (EPS) mode under average summer conditions for 14 days, and showed a consistent, repeating pattern of water age at all nodes after approximately 10 days. This indicates the maximum residence time in the distribution system under average summer conditions is approximately 10 days. The water age option was used in the model to obtain residence time throughout the distribution system. In addition to residence time calculations, the model was used to define influence zones of the two source waters. The source tracing option was used in the model to determine the average contribution of the two water sources to each node in the model.

Three zones were defined based on the two water sources:

- The area served primarily by the Adams WTP
- The area served primarily by the Lincoln WTP
- The area that generally received water from both treatment plants over the course of the day, either as a mixture or on an alternating basis

Because the Stage 1 DBPR compliance data indicates that DBP levels are highest in the Big City distribution system during the summer months, average day demands for the summer were used to determine residence times and mixing zones. Average day demands during winter conditions were also examined and the mixing zone was found to be very similar to the summer conditions.

The residence time data obtained from the model for the summer conditions were compared with the total chlorine residual data at the TCR monitoring sites for May and August (Table K.1). In general, there is a direct correlation between model-predicted residence times and total chlorine residuals. Sites on the periphery of the distribution system have longer residence times and lower total chlorine residuals, except for areas where booster chloramination is used. Sites which are under the influence of the booster facilities maintain relatively high total chlorine residuals. However, these sites also have high residence times. Table K.1 also summarizes model-predicted residence times at each of the TCR monitoring sites.

The residence times from the model were used to select 16 of the 20 TCR monitoring sites for DBP monitoring. These sites are described in further detail in the following section. After the selection of 16 sites, one round of DBP dual samples was taken at these sites during August, which is the month of historically high DBP levels. The residence time data, Stage 1 DBPR compliance data (Table K.2), and DBP data from this new round of sampling were then used to select Stage 2B compliance monitoring sites.

Available Data:

Report all data that helped in site selection. If you have bromide, TOC, and or HPC data, these may be helpful for justifying Stage 2B site selection.

Total chlorine residual data for the months of February, May, August, and November, and residence time data for summer demand conditions obtained from the water distribution system model, at TCR monitoring sites is presented in Table K.1. Quarterly Stage 1 DBPR compliance monitoring data is presented in Table K.2.

Table K.1 Big City Distribution System—Total Chlorine Residual at TCR Monitoring Sites

Monitoring Site	Free Chlorine Residual (mg/L)				Residence Time During Summer Demand Conditions (days)
	Nov. 2004	Feb. 2005	May 2005	Aug. 2005	Residence Time
TCR #1	3.2	3.4	3.5	3.6	0.1
TCR #2	3.0	3.2	3.3	3.4	0.2
TCR #3	2.4	2.3	1.9	1.8	4.1
TCR #4	2.3	2.5	1.8	2.0	3.9
TCR # 5	3.0	2.9	2.6	2.5	2.1
TCR # 6	2.9	3.0	2.7	2.4	1.8
TCR # 7*	2.9	3.1	1.8	2.0	5.5
TCR # 8	1.8	1.4	1.1	1.0	6.6
TCR # 9	3.3	3.4	3.4	3.5	0.1
TCR # 10	3.4	3.3	3.5	3.4	0.1
TCR # 11	2.5	2.6	2.0	1.8	1.9
TCR # 12	2.7	2.4	1.9	1.7	2.2
TCR # 13	2.5	2.2	1.7	1.9	3.2
TCR # 14	2.4	2.2	2.0	1.8	4.1
TCR # 15	1.4	1.5	1.2	1.3	6.7
TCR # 16	1.6	1.6	1.3	1.1	7.0
TCR # 17	1.9	2.2	2.0	1.8	3.4
TCR # 18	2.6	2.4	2.6	2.5	1.3
TCR #19	3.0	3.1	1.9	2.2	5.3
TCR # 20	2.0	1.9	1.5	1.6	4.4

Note: Site 7 is located downstream of Booster Station A.

Table K.2 Big City Distribution System—Stage 1 DBPR Monitoring Results

Monitoring Site	TTHM (µg/L)		HAA5 (µg/L)	
	Last 4 Quarters Data[1]	Aug. 2005 LRAA	Last 4 Quarters Data[1]	Aug. 2005 LRAA
Adams Plant average residence time Site Number 1	45, 34, 56, 62	49	24, 32, 43, 45	36
Adams Plant average residence time Site Number 2	32, 34, 48, 67	45	42, 47, 55, 56	50
Adams Plant average residence time Site Number 3	36, 42, 45, 45	42	50, 62, 67, 68	62
Adams Plant maximum residence time Site Number 4	64, 68, 83, 74	72	21, 25, 26, 28	25
Lincoln Plant average residence time Site Number 5	44, 20, 62, 42	42	34, 45, 33, 41	38
Lincoln Plant average residence time Site Number 6	46, 49, 39, 50	46	22, 30, 39, 41	33
Lincoln Plant average residence time Site Number 7	41, 22, 50, 59	43	4, 46, 64, 58	54
Lincoln Plant maximum residence time Site Number 8	73, 50, 67, 58	62	19, 22, 37, 30	27

[1] Data listed in order for November 2004 and February, May, and August 2005 quarterly sampling.

6. Description of SSS monitoring sites:

Present the rationale for selection of the SSS monitoring sites, as well as a schematic showing their location within the distribution system.

SSS monitoring sites were selected based on modeling results and available total chlorine residual data. The sites represent diverse geographical areas of the distribution system and are shown on the map of the distribution system in section 7.

Sites #1 and #2 represent the entry point to the distribution system from Adams Plant. The residence time at these sites is about 2 to 4 hours.

Sites #3 and #4 are representative of predicted high HAA5 concentrations in the zone served by the Adams WTP. These sites are located on 6-inch dead-end lines near the extremities of the system. As a result, travel time (and thus water age) to these sites is long, approximately 4 days, based on the water age modeling. However, the modeling indicates that these sites are always fed directly from the treatment plant (the water does not go through a storage tank) and routine sampling has shown that there are adequate chlorine residuals at these sites. As a result, biodegradation is not expected to occur, and high HAA5 concentrations are expected.

Sites #5 and #6 were selected to represent average conditions in the zone fed by Adams WTP. Monitoring results indicated an average total chlorine residual at these sites of 2.8 mg/L during the summer. Modeling shows that typical water age at these sites is approximately 2 days.

Site #7 was selected to represent high TTHM levels in the Adams WTP zone. This site is downstream of the Chlorine Booster Station A; thus, the chlorine residuals are relatively high. The model indicated that the water age is high (around 5 days).

Site #8 is representative of high TTHM levels in the mixing zone and is counted as one of the eight sites required for the Adams WTP. Modeling shows that water age at this site is generally high (> 6 days) throughout the day, representing water that has traveled a significant distance and that has usually been through one of the storage tanks.

Sites #9 and #10 represent the entry point to the distribution system from the Lincoln Plant. The residence time of these sites is about 2 hours.

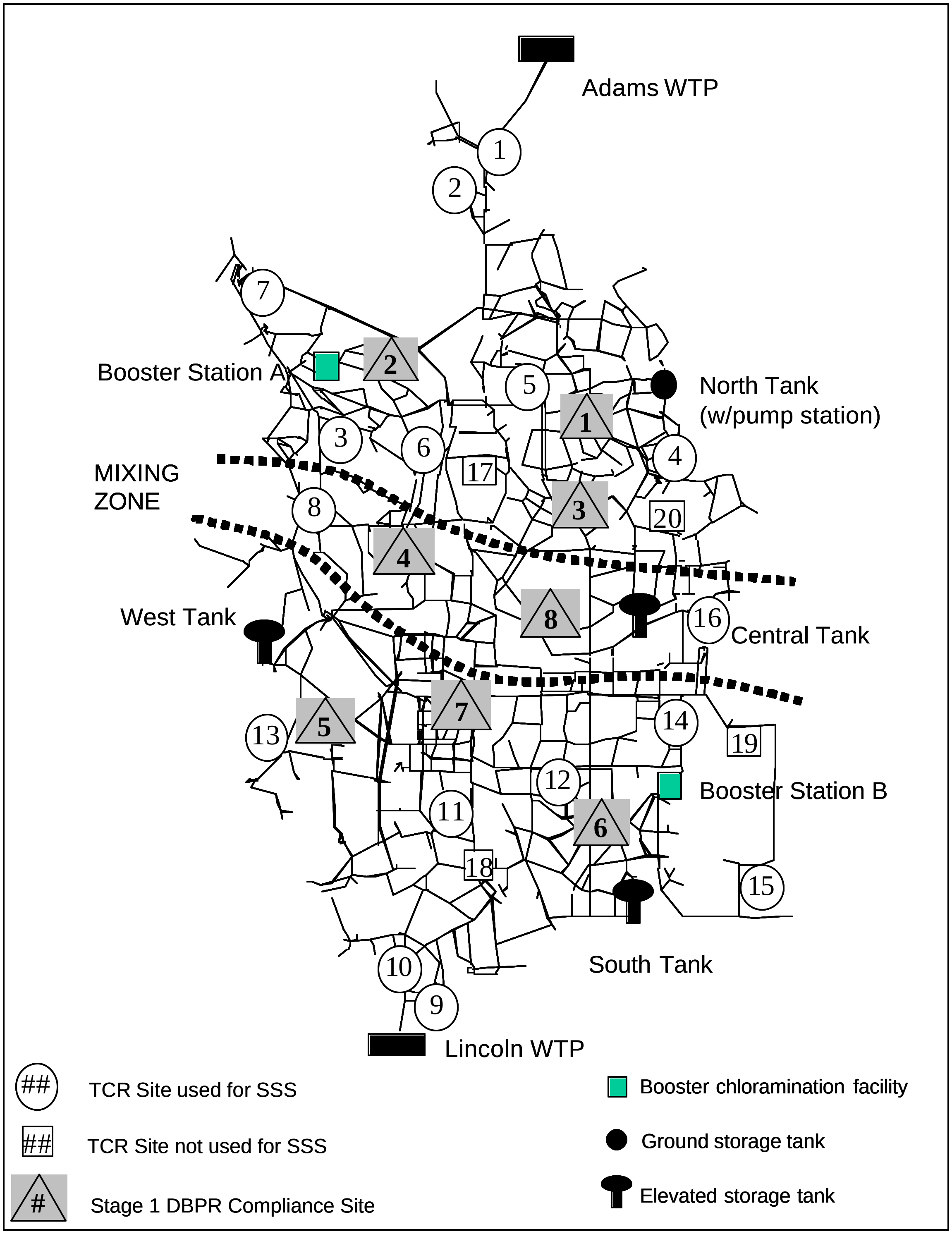
Sites #11 and #12 were selected to represent average conditions in the area served by Lincoln WTP. Water age modeling indicated the residence times for these sites are approximately 2 days.

Sites #13 and #14 represent expected high HAA5 concentrations in the zone served by the Lincoln WTP. These sites are located on 12-inch looped lines with low water demand near the extremities of the system. As a result, travel time (and thus water age) to these sites is approximately 3 to 4 days, based on the water age modeling. However, the modeling indicates that the sites are always fed directly from the Lincoln WTP and routine sampling has shown that the total chlorine residual at these sites is usually about 2.3 mg/L during the summer. As a result, biodegradation is not expected to occur, and high HAA5 concentrations are expected.

Site #15 is located on the eastern extremity of the system beyond the South Tank. Based on modeling, it was determined that, due to the travel time from the plant to this site and the effects of South Tank, the water age at this site typically exceeds 5 days. This site represents high TTHM.

Site #16 is representative of high TTHM levels in the mixing zone and is counted as one of the eight sites required for the Lincoln WTP. Modeling shows that water age at this site is generally high (> 6 days) throughout the day, representing water that has traveled a significant distance and that has usually been through one of the storage tanks.

7. Map of the distribution system showing major transmission mains, Stage 1 DBPR compliance sites, and SSS sites:



8. Summary of SSS monitoring results:

One round of DBP samples was collected in August 2005 at the SSS sites listed in section 6. August is historically the high DBP month for Big City. The results from this sampling are presented in the following tables, with separate sections for each plant and the sites in order according to TTHM results, from highest to lowest. For comparison, Stage 1 DBPR sampling results for the month of August 2005 and the LRAAs as of August 2005 (shown in parentheses) are also presented in the table ranked by individual TTHM sample results.

Adams Plant TTHM and HAA5 Test Results

Site #	Type	TTHM Result (µg/L)	HAA5 Result (µg/L)
Adams Plant SSS Sites - August 2005			
SSS #7	High TTHM	83	48
SSS #8	High TTHM	62	45
SSS #3	High HAA5	50	50
SSS #5	Average Residence Time	48	45
SSS #4	High HAA5	48	32
SSS #6	Average Residence Time	45	30
SSS #2	Near Entry Point	34	28
SSS #1	Near Entry Point	32	30
Site #	**Type**	**TTHM Result (LRAA) (µg/L)**	**HAA5 Result (LRAA) (µg/L)**
Adams Plant Stage 1 DBPR Sites - August 2005			
Stage 1 #4	Max. Residence Time	74 (72)	28 (25)
Stage 1 #2	Avg. Residence Time	67 (45)	56 (50)
Stage 1 #1	Avg. Residence Time	62 (49)	45 (36)
Stage 1 #3	Avg. Residence Time	45 (42)	68 (62)

Lincoln Plant TTHM and HAA5 Test Results

Site #	Type	TTHM Result (µg/L)	HAA5 Result (µg/L)
Lincoln Plant SSS Sites - August 2005			
SSS #16	High TTHM	76	48
SSS #15	High TTHM	73	36
SSS #13	High HAA5	66	35
SSS #14	High HAA5	62	58
SSS #11	Average Residence Time	52	40
SSS #12	Average Residence Time	50	42
SSS #9	Near Entry Point	40	34
SSS #10	Near Entry Point	44	32
Lincoln Plant Stage 1 DBPR Sites - August 2005			
Site #	**Type**	**TTHM Result (LRAA) (µg/L)**	**HAA5 Result (LRAA) (µg/L)**
Stage 1 #7	Avg. Residence Time	59 (43)	58 (54)
Stage 1 #8	Max. Residence Time	58 (62)	30 (27)
Stage 1 #6	Avg. Residence Time	50 (46)	41 (33)
Stage 1 #5	Avg. Residence Time	42 (42)	41 (38)

9. Proposed Stage 2B monitoring sites:

Big City is a system serving 55,000 people that uses two surface water sources. Therefore, Big City is required to designate four (4) Stage 2B compliance monitoring sites for each plant resulting in a total of eight (8) Stage 2B compliance monitoring sites. A summary of these requirements is presented in the following table.

Stage 2B Compliance Monitoring Requirements

Site Criteria	Number of Sample Sites	
	Adams WTP Influence Zone	Lincoln WTP Influence Zone
Stage 1 average residence time sites	1	1
Representative of high HAA5	1	1
Representative of high TTHM	2	2

Based on the modeling results, Stage 1 DBPR data, and additional DBP sampling results at the SSS monitoring sites, we are proposing the Stage 2B compliance monitoring sites listed in the following table. The rationale for their selection follows.

Stage 2B Proposed Compliance Sample Sites

Stage 2B Sites			Site Description (Previous Site ID)
No.	**Plant**	**Type**	
1	Adams	Average	Stage 1 DBPR average residence time (Stage 1 #3)
2	Adams	Highest HAA5	Stage 1 DBPR average residence time (Stage 1 #2)
3	Adams	Highest TTHM	High TTHM from Adams Plant (SSS #7)
4	Adams	Highest TTHM	Stage 1 DBPR maximum residence time (Stage 1 #4)
5	Lincoln	Average	Stage 1 DBPR average residence time (Stage 1 #7)
6	Lincoln	Highest HAA5	High HAA5 from Lincoln Plant (SSS #14)
7	Lincoln	Highest TTHM	High TTHM from Lincoln Plant (SSS #16)
8	Lincoln	Highest TTHM	High TTHM from mixing zone (SSS #15)

- Stage 2B Site #1: This is the average residence time site for the Adams WTP influence area. It had the highest HAA5 test result in the August round of sampling of all the sites, both SSS and Stage 1 DBPR. It also had the highest HAA5 LRAA (62 µg/L) of the Stage 1 DBPR sites, and this LRAA exceeds the MCL. The other two Stage 1 DBPR average residence time sites had higher individual TTHM results and TTHM LRAAs, but their HAA5 results and LRAAs were significantly less. This site (the old Stage 1 DBPR #3) is also in the geographic center of the Adams Plant influence area.

- Stage 2B Site #2: This is the representative high HAA5 site for the Adams WTP influence area. It had the second highest (after Stage 2B #1) HAA5 result of the 12 sites. It is located on the south central region of the distribution system.

- Stage 2B Site #3: This is one of two representative high TTHM sites for the Adams WTP influence area. It had the highest TTHM result of the 12 Adams WTP sites. It is on the western periphery of the Adams WTP influence area and downstream of Booster Station A, which is used intermittently during the summer.

- Stage 2B Site #4: This is the second of the representative high TTHM sites for the Adams WTP influence area. It had the second highest TTHM result of the 12 Adams sites, and because it was the Stage 1 DBPR maximum residence time location, its continued use will maintain an uninterrupted historic record of DBP levels at the site. It is in the mixing zone in the center of the city.

- Stage 2B Site #5: This is the average residence time site for the Lincoln WTP influence area. It had the highest TTHM and HAA5 test results in the August round of sampling of the Stage 1 DBPR average sites. Its TTHM LRAA was not as high as one of the other two Stage 1 DBPR average sites (old Stage 1 DBPR #6), but its HAA5 LRAA was the highest HAA5 LRAA of the Stage 1 sites by a large margin. This site (the old Stage 1 DBPR #7) is also in the geographic center of the Lincoln Plant influence area.

- Stage 2B Site #6: This is the representative highest HAA5 site for the Lincoln WTP influence area. It had the highest HAA5 result of the 8 Lincoln SSS sites. It is located on the eastern periphery of the Lincoln WTP influence area and has historically always had a measurable total chlorine residual, which is most likely due to the effect of the frequent operation of Booster Station B.

- Stage 2B Site #7: This is the first of two representative highest TTHM sites for the Lincoln WTP influence area. It had the highest TTHM result of the 12 Lincoln WTP sites, and is located in the mixing zone in the central portion of the city.

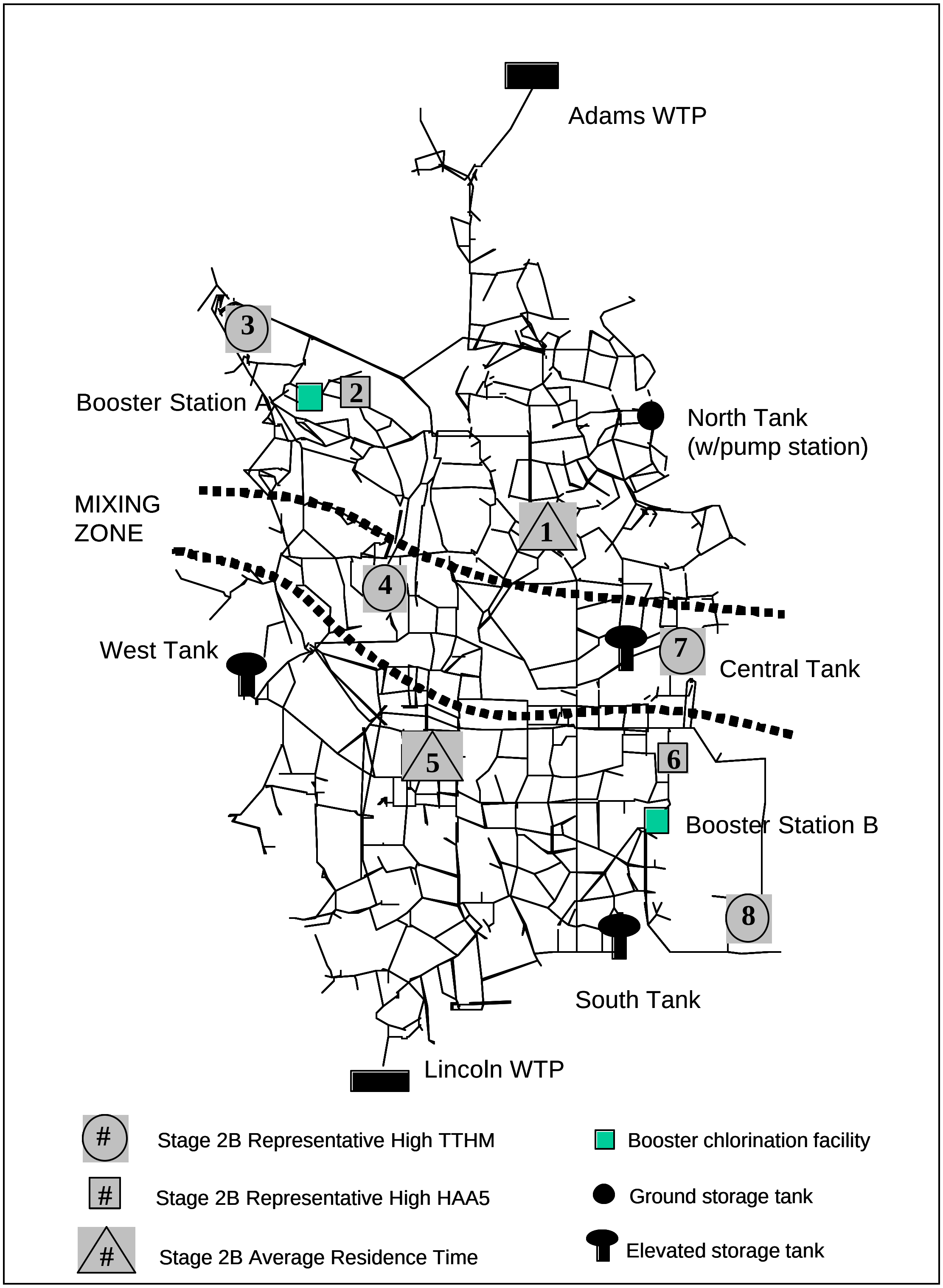
- Stage 2B Site #8: This is the second of the representative highest TTHM sites for the Lincoln WTP influence area. It had the second highest TTHM result of the 12 Lincoln sites. It is on the eastern edge of the city.

The map on the following page shows the proposed Stage 2B compliance monitoring sites.

10. Proposed Stage 2B Compliance Monitoring Schedule:

Stage 2B compliance monitoring will be scheduled for the first week of February, May, August, and November. This is the same as the Stage 1 DBPR and Stage 2A DBPR sampling, because August is the historic month of maximum DBP levels and water temperature in the distribution system.

11. Proposed Stage 2B compliance monitoring sites:



This page intentionally left blank.

Appendix L

IDSE System-Specific Study Using Historical Data

This appendix is provided as an example IDSE report for a producing system opting to complete a System-Specific Study (SSS) using historical DBP data.

Chapter 3 presents detailed guidance on the requirements for performing an SSS with historical data and guidance on the selection of Stage 2B compliance monitoring sites using SSS data. Chapter 3 also presents the IDSE reporting requirements for systems conducting an SSS. The application of the basic guidance on the use of historical data to select sites meeting the SMP site criteria and the use of the data to select Stage 2B compliance monitoring sites is shown in this example, along with several instances of the use of best professional judgement being applied.

The italicized text within the appendix consists of comments and explanations and is not intended to represent the recommended content of an actual IDSE Report.

This page intentionally left blank.

Initial Distribution System Evaluation Report for Magnolia City

PWSID Number: US0000000

Address: P.O. Box 1234
Magnolia City, US 11111-1234

Contact Person: Ms. Mary Flower, P.E.

Phone Number: 234-555-1111

Fax Number: 234-555-2222

Email Address: Mflower@ci.magnolia.us

System Type: Community, surface water

Population Served: 125,000

This page intentionally left blank.

1. System Description:

This section of the report should include a summary of typical system operating characteristics (and how they change on a seasonal basis if appropriate) explaining how sources are used to meet system demands, where high water age is expected to occur, and any special aspects of operation that could affect DBP concentrations in the distribution system. Information about water treatment processes and source water quality data is also part of this section, including a description of actual residence times within the water treatment plant and the distribution system.

General system characteristics:

Service Area: Magnolia City plus surrounding suburban areas
Production: Annual average daily demand 35 MGD

Source Water Information:

Grand Falls River

pH: from 6.7 to 7.7
Alkalinity: from 73 to 104 mg/L as $CaCO_3$
TOC: from 1.8 to 5.4 mg/L as C

Entry points (tied to source(s) and identification of service area(s) under the influence of each entry point:

Entry points: River Run Plant, serves the entire service area

Treatment Provided:

River Run Plant, coagulation (with ferric chloride), flocculation, sedimentation, and dual media filtration (filter loading rates are approximately 4 gpm/sf). Chlorine is used for both primary and residual disinfection.

Description of distribution system:

Distribution system (estimated length of lines and range of diameter):
About 800 miles, 4" - 56"

11storage tanks with a total of 19 MG capacity

4 elevated tanks 2.0 MG each (8 MG)
2 elevated tanks, 1.5 MG (3 MG)
2 elevated tanks, 0.5 MG (1 MG)
3 ground tanks (two 2 MG and one 3 MG, 7 MG total capacity)

The average residence time of water in the distribution system is estimated as two days.

Pump stations:
Station #1 is located at the ground storage tank on North Boulevard. This station is primarily used during peak demands and low pressure situations. The pump is timed to turn on in the morning and evening during peak demand, and when the pressure drops below 40 psi at a point downstream of the pump station.

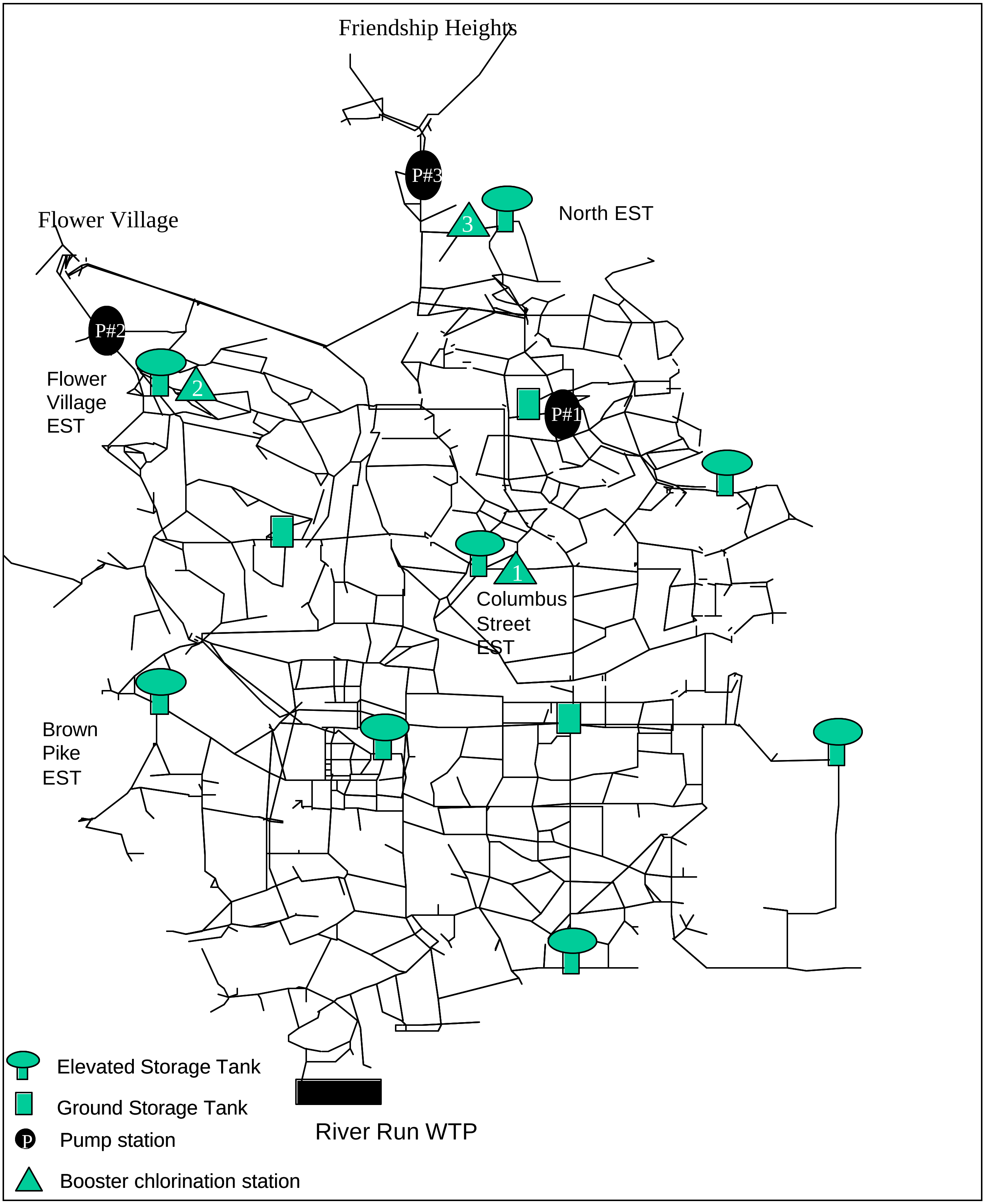
Stations #2 and #3. These pumps are used to boost system pressure when the pressure in the areas downstream of these pumps (Flower Village and Friendship Heights) drops below 40 psi.

Booster chlorination facilities:
Facility #1 is located in proximity to Freedom Square (downstream of the Columbus St. storage tank). This facility is occasionally used during the summer when remote locations downstream of the booster chlorination facility lose residual.

Facility #2 is located at the Flower Village elevated tank, in an area of the distribution system where chlorine residuals are frequently low.

Facility #3 is located near the North Village (downstream of the north storage tank) in an area of the distribution system where chlorine residuals are frequently low.

2. Schematic of the distribution system:



3. SMP monitoring requirements:

Magnolia City is a system serving 125,000 people that uses one surface water source. Instead of an IDSE SMP, an IDSE SSS has been performed based on historical system-specific monitoring data that are comparable or superior to data that would be collected at monitoring sites required by the Standard Monitoring Program. A comparison of SMP monitoring site requirements and sites used as a part of this SSS is presented in the following table.

Comparison of SMP and SSS Monitoring Sites

Site Criteria	Number of Sample Sites	
	Required by SMP	Provided in SSS
Near-entry to the distribution system	1	1
Average residence time	2	4
Representative of high TTHM	3	5
Representative of high HAA5	2	2
Total	8	12

4. Description of Historical Data:

The selected SSS sites have been monitored three times a year for a period of five years (1999-2003). This monitoring was conducted separately from Stage 1 DBPR compliance monitoring. TTHM testing for the entire 5- year period was performed by certified labs. HAA5 testing was performed by certified labs beginning in 2002, so HAA5 data provided by non-certified labs in the previous years were not considered and have not been included in this report.

During the 5-year period of DBP monitoring, there were no significant, long-term changes made at the water treatment plant or in the operation of the distribution system. There have been no process changes at the plant, and no new tanks, pump stations, or significant water mains added to the distribution system. A small booster chlorination facility was added to the North EST in the spring of 2003, which allows chlorine to be added to water flowing out of the tank. This helped increase the chlorine residual levels in the area around and past the tank in the summer of 2003. The area affected by this new chlorine booster facility is limited to the area that receives water from this 0.5 MG tank, so the area is relatively small.

Available Data:

Report all data that helped in site selection. If you have bromide, TOC, or HPC data, these may be helpful for justifying selection of Stage 2B sites.

Table L.1 summarizes free chlorine residual data at each of the city's 24 TCR monitoring sites. Of these 24 sites, 12 have been monitored for DBP's over the last 5 years and were selected as SSS monitoring sites. Table L.2 presents HPC data for the 24 TCR monitoring sites

The historical sampling stations were chosen in 1999 to represent diverse geographical areas of the distribution system, using water quality data collected in 1997 and 1998 for free residual chlorine (Table L.1) and heterotrophic plate counts (HPC) (Table L.2). The extent of this network of 12 monitoring stations is, in our opinion, superior to the eight monitoring stations required by the IDSE SMP for a system under the influence of one surface water source.

Table L.3 in section 7 presents TTHM and HAA5 test results for the 12 TCR monitoring sites where TTHM and HAA5 testing has been conducted on a regularly scheduled basis for the last 5 years.

Table L.1 Magnolia City—Free Chlorine Residual Data (mg/L)

TCR Site #	Location	SSS #	11/97	02/98	05/98	08/98	Average
1	Lakeshore Dr	7	0.5	0.8	0.9	0.4	0.7
2	Dogwood Dr	5	0.7	0.6	0.8	1.0	0.8
3	Brown Pike	6	0.6	0.9	1.1	0.8	0.9
4	Near Heights	8	0.7	0.7	0.4	0.2	0.5
5	Museum Rd	2	0.6	0.7	0.6	0.8	0.7
6	Country Club Rd	9	0.2	0.6	0.3	0.2	0.3
7	Logan Pl	12	0.5	0.3	0.2	0.5	0.4
8	Langley Ave		0.8	0.9	1.2	1.1	1.0
9	Grant Hill Pl		0.6	0.6	0.5	0.9	0.7
10	River Run entry point	1	1.4	1.2	1.3	1.7	1.3
11	Gray Sq	10	0.3	0.6	0.1	0.0	0.1
12	Pink Ln		0.2	0.3	0.5	0.3	0.6
13	Oak Dr		0.8	0.9	0.3	0.8	0.7
14	Sea Dr		0.2	0.8	0.8	0.5	0.6
15	River Rd		0.2	1.0	0.7	0.1	0.6
16	Lake Ave		0.9	0.7	1.0	1.2	1.0
17	Hardwood Sq		0.9	1.2	1.0	0.8	1.0
18	Long Dr		1.6	1.4	1.6	1.5	1.5
19	Colonial Plaza		0.8	0.6	0.9	0.8	0.8
20	Butler Pl	4	0.6	0.2	0.5	0.4	0.4
21	Sunset Rd	11	ND	0.1	0.1	0.3	0.1
22	Gatewood Ln		0.2	0.2	0.2	0.5	0.3
23	Morgan Ave	3	0.6	0.4	0.4	0.6	0.5
24	Central Street		ND	0.2	ND	0.1	0.1

ND - Non Detect

Table L.2 Magnolia City—Heterotrophic Plate Counts (cfu/mL)

TCR Site #	Location	SSS #	11/97	02/98	05/98	08/98	Average
1	Lakeshore Dr	7	50	34	63	113	65
2	Dogwood Dr	5	53	64	123	94	83
3	Brown Pike	6	56	42	276	345	180
4	Near Heights	8	82	136	246	146	152
5	Museum Rd	2	66	53	53	153	81
6	Country Club Rd	9	70	212	332	356	242
7	Logan Pl	12	54	65	65	93	69
8	Langley Ave		69	43	43	37	48
9	Grant Hill Pl		43	34	224	156	114
10	River Run entry point	1	67	14	42	35	40
11	Gray Sq	10	140	215	615	857	456
12	Pink Ln		280	163	263	746	363
13	Oak Dr		50	42	522	223	209
14	Sea Dr		140	66	236	364	201
15	River Rd		196	45	425	853	380
16	Lake Ave		53	42	72	84	63
17	Hardwood Sq		35	43	45	64	47
18	Long Dr		12	8	12	34	17
19	Colonial Plaza		78	86	364	384	228
20	Butler Pl	4	34	76	89	97	74
21	Sunset Rd	11	156	278	359	469	315
22	Gatewood Ln		233	214	546	656	412
23	Morgan Ave	3	35	62	92	147	84
24	Central Street		68	175	375	399	254

5. Description historical sample sites:

A description of the characteristics used to select the twelve historical sites used for DBP monitoring in the distribution system is given here. These sites are presented graphically in section 3. Historical DBP data for these sites is presented in section 8.

Historical Site #1 – Entry point to the distribution system for River Run Water Treatment Plant. This site is located just after the first significant group of connections downstream of the plant.

Historical Site #2 – Represents average residence time of water leaving the plant. We estimated the point where the chlorine decays to about 50 percent of its original residual concentration (at the high service pumps). There are no storage facilities between the plant and this site.

Historical Site #3 – Represents average residence time. Water at this site does not go through a storage facility, and the chlorine residual is generally 35 to 40 percent of the River Run Plant effluent concentration. We attribute this additional loss of chlorine to the fact that the transmission and distribution lines serving this area are older unlined cast iron and have significant build-up of corrosion by-products (tubercles). We believe that these corrosion by-products exert a chlorine demand which results in lower chlorine residual at this site, although it is probably lower in water age than Site #2.

Historical Site #4 – Represents average residence time. The site is used as an alternative site for our coliform and chlorine residual monitoring.

Historical Site #5 – Represents average residence time. The chlorine residual at this site is generally 45 to 50 percent of the plant effluent concentration.

Historical Site #6 – Represents high TTHM levels. This sampling site is downstream of the Brown Pike Storage Tank (a 1.5 MG elevated tank). The sampling station is located downstream of the tank before the last group of connections (approximately 0.5 miles) to be representative of water delivered to customers.

Historical Site #7 – Represents high TTHM levels. This site is the last dedicated sampling site downstream of the Flower Village EST and is used for routine Total Coliform Rule and chlorine residual monitoring. We have over 7 years of data from this site. This site is located before the last group of connections near the end of the system, where the water demand tends to be relatively low.

Historical Site #8 – Represents high TTHM levels. This sample site is a faucet at a connection located in a zone of the distribution system that has been recently developed. Chlorine residuals are normally in the 0.2 to 0.7 mg/L range.

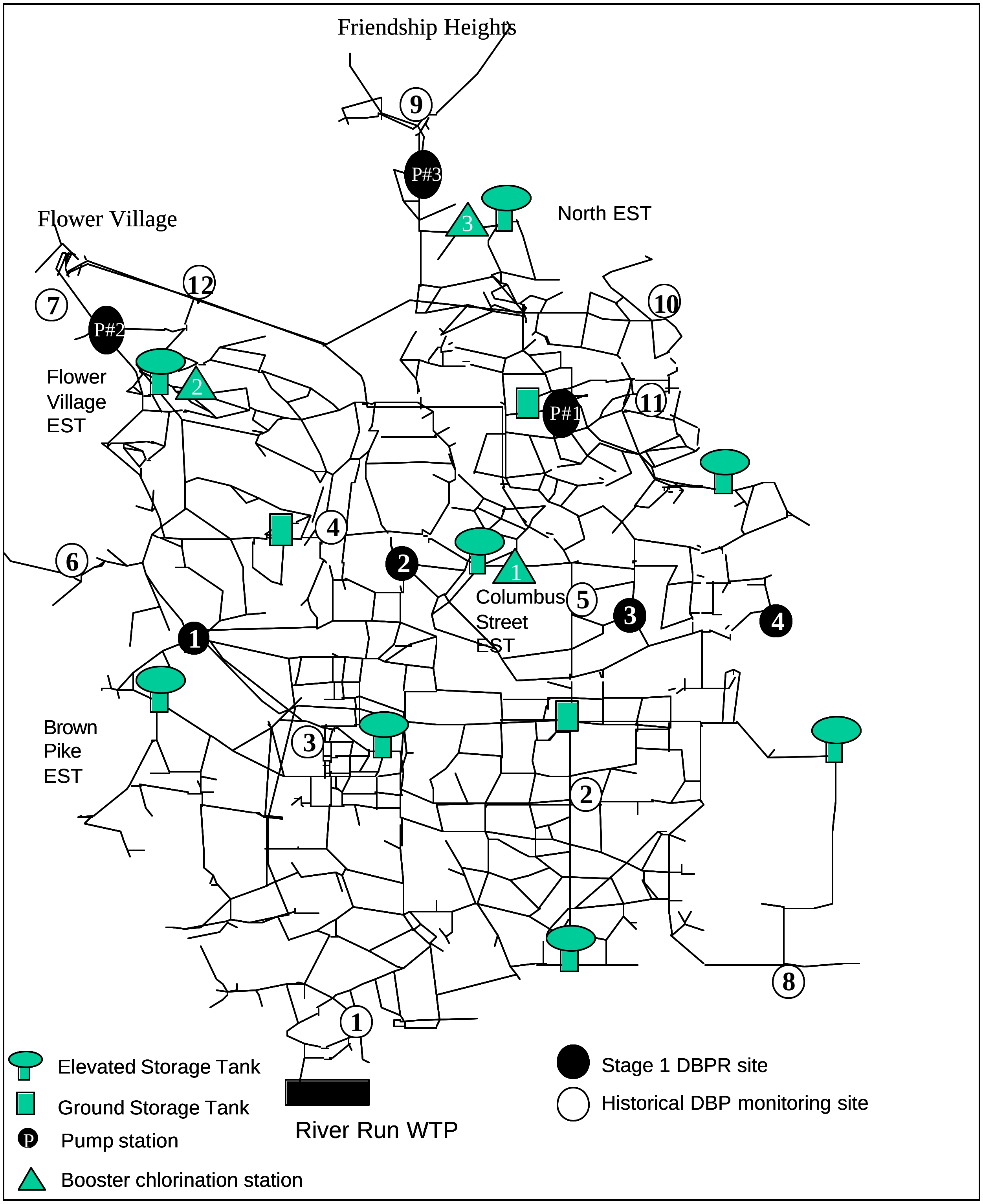
Historical Site #9 – Represents high TTHM levels. This site is downstream of the North Storage Tank, a 0.5 MG elevated tank with a booster chlorination facility that was recently added to aid in maintaining a chlorine residual.

Historical Site #10 – Represents high TTHM levels. This site has been problematic in the past, with the occurrence of coliform bacteria, non-detectable chlorine residuals, high heterotrophic plate count, and odor complaints. A 4-inch blow-off was installed downstream of this site, but the site continues to have poor water quality.

Historical Site #11 – Represents high HAA5 levels. Although chlorine residual levels are often low at this site, there has never been an occurrence of a heterotrophic plate count greater than 500 cfu/mL or a positive coliform bacteria test.

Historical Site #12 – Represents high HAA5 levels. Sample tap is a hose bib at a building located in a zone of the distribution system with water age greater than average. Chlorine residual at this site ranges from 0.2 to 0.5 mg/L, and the heterotrophic plate count is consistently below 100 per mL all year round.

6. Map of the distribution system showing major transmission mains, numbered Stage 1 DBPR compliance sites, and numbered historical sample sites:



7. Summary of historical DBP data and Stage 1 DBPR compliance data:

Data for five years of TTHM monitoring and two years of HAA5 monitoring are presented in Table L.3. Data were collected three times a year, during April, July, and October. No winter samples were taken. The historical monitoring did not include sampling during August—the peak historical month for water temperature and DBPs (based on Stage 1 DBPR compliance monitoring provided below). Therefore, a single set of additional samples was collected at the 12 historical sites in August 2003 and the results included as part of the 2003 monitoring data in the following table. The August value is included in the table to allow for a comparison between the individual sampling results. However, the August 2003 results were not included in the calculation of the 2003 yearly averages because this would have prevented a direct comparison of the 2003 averages to the averages from previous years that do not include an August sample result.

Table L.3 Magnolia City Historical DBP Monitoring Results (1999-2003)

SSS Sample Site	Year	TTHM (µg/L) Monitoring Data[1]	TTHM (µg/L) 08/03	TTHM (µg/L) Avg	HAA5 (µg/L) Monitoring Data[1]	HAA5 (µg/L) 08/03	HAA5 (µg/L) Avg
#1 - Plant entry point	1999	36, 92, 89		72			
	2000	24, 78, 93		65			
	2001	33, 15, 24		24			
	2002	24, 35, 46		35	21, 15, 68		35
	2003	37, 45, 58	69	47	38, 58, 53	46	50
#2 - Average residence time	1999	66, 82, 80		76			
	2000	76, 94, 83		84			
	2001	72, 98, 79		83			
	2002	51, 75, 80		69	29, 35, 41		35
	2003	44, 68, 71	78	61	45, 50, 48	56	48
#3 - Average residence time	1999	56, 71, 63		63			
	2000	36, 84, 103		74			
	2001	62, 68, 54		61			
	2002	41, 58 , 69		70	24, 23, 74		40
	2003	41, 65, 70	74	59	47, 63, 59	48,	56
#4 - Average residence time	1999	61, 77, 75		71			
	2000	68, 86, 75		79			
	2001	67, 88, 79		78			
	2002	56, 75, 75		69	34, 33, 54		40
	2003	47, 71, 74	85	66	43, 68, 63	59	58
#5 - Average residence time	1999	55, 70, 62		62			
	2000	35, 83, 82		67			
	2001	60, 66, 52		59			
	2002	43, 60 , 71		72	22, 21, 64		37
	2003	39, 63, 69	92	57	48, 62, 58	36	56
#6 - High TTHM	1999	85, 71, 93		83			
	2000	82, 92, 102		92			
	2001	70, 72, 95		79			
	2002	61, 81, 85		76	40, 56, 68		55
	2003	68, 76, 80	123	75	50, 50, 58	23	53

SSS Sample Site	Year	TTHM (µg/L)			HAA5 (µg/L)		
		Monitoring Data[1]	08/03	Avg	Monitoring Data[1]	08/03	Avg
#7 - High TTHM	1999	82, 69, 83		78			
	2000	92, 102, 112		102			
	2001	90, 92, 105		96			
	2002	71, 91, 95		86	45, 33, 25		34
	2003	88, 96, 100	98	95	30, 60, 68	63	53
#8 - High TTHM	1999	75, 80, 82		79			
	2000	65, 103, 112		93			
	2001	60, 106, 152		106			
	2002	53, 80, 91		75	32, 31, 23		29
	2003	89, 55, 99	152	81	28, 33, 49	44	37
#9 - High TTHM	1999	80, 85, 87		84			
	2000	75, 93, 109		92			
	2001	70, 110, 98		93			
	2002	73, 100 , 101		95	35, 36, 28		34
	2003	84, 90, 94	132	89	31, 39, 59	47	45
#10 - High TTHM	1999	78, 87, 89		85			
	2000	85, 103, 119		102			
	2001	60, 120, 108		96			
	2002	75, 102 , 103		98	34, 36, 30		33
	2003	54, 70,114	92	79	45, 19, 29	26	31
#11 - High HAA5	1999	56, 71, 63		63			
	2000	37, 85, 84		69			
	2001	63, 69, 55		62			
	2002	42, 58 , 69		69	42, 71, 55		56
	2003	41, 65, 71	83	59	50, 65, 79	82	65
#12 - High HAA5	1999	56, 72, 70		66			
	2000	63, 81, 70		74			
	2001	62, 83, 74		73			
	2002	51, 70, 70		64	44, 43, 25		37
	2003	42, 66, 69	90	61	53, 68, 83	78	68

[1] Data obtained from sampling at approximate 90 day intervals each year are listed in order for April, July, and October. Bold values are August 2003 results and are not included in the calculated averages.

Stage 1 DBPR sampling occurred as scheduled from November 2002 through August 2003. These data are presented in the following table.

Magnolia City—Stage 1 DBPR Monitoring Results for 2003

Monitoring Site	TTHM (µg/L)		HAA5 (µg/L)	
	Individual Results[1]	LRAA	Individual Results[1]	LRAA
Average residence time #1	45, 34, 51, 67	49	24, 27, 43, 50	36
Average residence time #2	36, 42, 41, 49	42	42, 47, 50, 61	50
Average residence time #3	32, 34, 43, 72	45	50, 62, 62, 73	62
Maximum residence time #4	64, 68, 74, 83	72	21, 25, 26, 28	25

[1] Data listed in order for November, February, May, and August quarterly sampling.

8. Proposed Stage 2B monitoring sites:

Magnolia City is a system serving 125,000 people and uses one surface water source. Therefore, Big City is required to propose a total of four Stage 2B compliance monitoring sites. A summary of these requirements is presented in the following table.

Stage 2B Compliance Monitoring Requirements

Site Criteria	Number of Sites
Stage 1 average residence time sites	1
Representative of high HAA5	1
Representative of high TTHM	2

Based on historical DBP data, Stage 1 compliance data, and other available water quality data (free chlorine residual and HPC), we are proposing the Stage 2B monitoring sites listed in the following table. The rationale for their selection follows. A schematic of the sites is presented in section 9.

Proposed Stage 2B Compliance Monitoring Sites

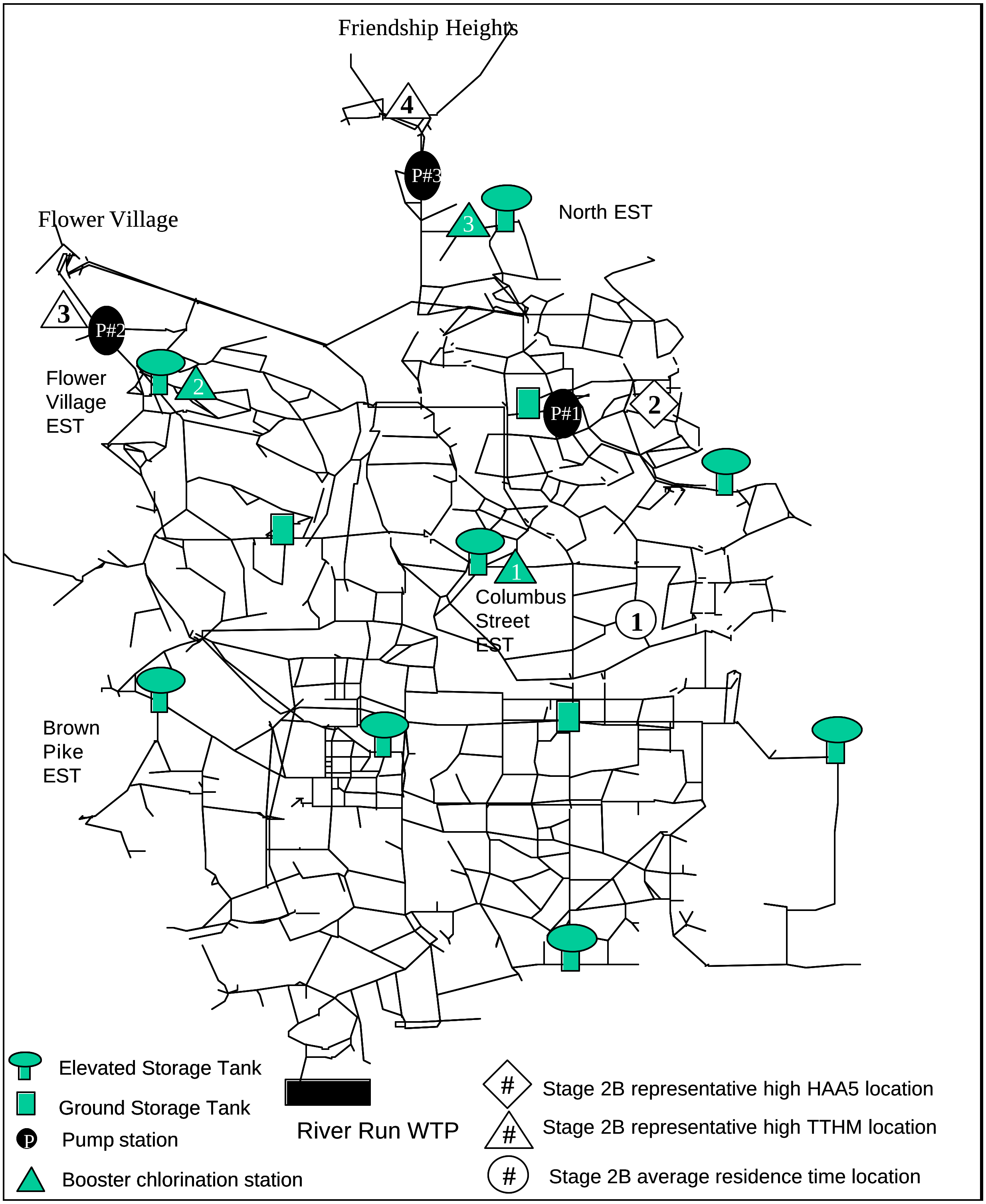
Sample Site	Site Description
Stage 2B Site #1	Stage 1 DBPR #3
Stage 2B Site #2	SSS #11 - High HAA5
Stage 2B Site #3	SSS #7 - High TTHMs
Stage 2B Site #4	SSS #9 - High TTHMs

1. One Stage 2B monitoring site representative of average residence time must be selected from the three Stage 1 DBPR average residence time sites. Stage 1 DBPR #3 was retained as the Stage 2B monitoring site representative of average residence time. This site had the highest individual TTHM concentration and the highest HAA5 LRAA. Because Stage 1 #3's HAA5 LRAA was much greater than the HAA5 LRAAs of the other two Stage 1 sites and the TTHM LRAAs of all three sites were relatively close, the decision was made to retain Stage 1 #3 as the Stage 2B average residence time compliance site.

2. One Stage 2B monitoring site must be representative of the highest HAA5 levels in the distribution system. Among all the SSS and Stage 1 DBPR sites, SSS #12 had the highest average HAA5 value during the 2003 sampling period (68 µg/L) but had a much lower average (37 µg/L) in 2002. SSS #11 had the highest average HAA5 values when considered together for 2002 and 2003, the only site to have such consistently high values. It is believed that the startup of Booster Chlorination Facility #2 in June 2003 resulted in an increase in HAA5 values at SSS #12, compared to the values seen the previous summer. Operation of Booster Chlorination Facility #2 is on an as needed basis, so it appears that if the booster facility is not operating, the HAA5 levels at SSS #12 will be much lower. Also, SSS #12 is geographically and hydraulically a little too close to Stage 2B #3. Therefore, based on our professional judgement of these factors, SSS #11 is proposed as the Stage 2B compliance monitoring site representative of highest HAA5.

3. Two Stage 2 DBPR monitoring sites must be representative of highest TTHM levels. Among all the SSS and Stage 1 DBPR sites, SSS #7 and #9 consistently had the highest average TTHM values during 1999-2003. Therefore, we propose SSS sites #7 and #9 as the Stage 2B compliance monitoring sites representative of highest TTHM.

9. Proposed Stage 2B compliance sample sites:



This page intentionally left blank.